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no. 2

THE SECOND REPORT

of the

RESIDENTIAL PLANNING PROJECT

of the

DEPARTMENT OF ARCHITECTURE, UNIVERSITY OF ILLINOIS

in cooperation with

BITUMINOUS COAL RESEARCH, INC.
AMERICAN COKE AND COAL CHEMICALS INSTITUTE
ANTHRACITE INSTITUTE

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I. ADDED SCOPE OF PROJECT

A new contract is in the process of being signed between the University of Illinois and Bituminous Coal Research, Inc., The American Coke and Coal Chemicals Institute, and The Anthracite Institute. This contract will increase the scope of the Residential Planning Project to include all solid fuels, which is most desirable. The interest and cooperation of the three organizations representing the solid fuels industries is very gratifying to the Residential Planning Project.

Unfortunately, most of this report had been prepared before the new co-sponsors were added. Hence, calculations of bin capacities, etc., are based on bituminous coal data and do not include the other solid fuels. However, many of the principles stated in the report are applicable to all solid fuels. In the future, this report will be revised to include both coke and anthracite. Copies of the report will be sent to all three of the co-sponsors.

II. STUDY: FACTORS INFLUENCING PLANNING FOR SOLID FUELS

The study on the following pages is intended as a framework for further study and investigation, and is in no sense to be interpreted as a final recommendation. Where recommendations are made, they are intended as suggestions. It is hoped that these suggestions, which in some cases may differ widely from present practices, will provoke thought and comment of those associated with the solid fuels industries.

This study includes the following sections, entitled:

Delivery
Solid Fuel Storage
Ash Removal
Heater Room
House and Plot Plans for Solid Fuel Use

DELIVERY

A. ULTIMATE AND PRACTICAL OBJECTIVES

1. From the Home Owner's Standpoint

General

A satisfactory fuel delivery, from a home owner's standpoint, should have (a) no dirt, (b) no damage, (c) no additional expense, and (d) little or no inconvenience. Ideally, the home owner's awareness of a fuel delivery should be limited to the signing of the delivery ticket.

Provide Clean Delivery

The owner does not want spilled coal left on his lawn, walks, or driveway; he does not want a layer of dust throughout the house as a result of delivery.

Eliminate Property Damage

The consumer does not want his property damaged during a fuel delivery. The lawn should not be marred with wheelbarrow or truck tracks, shrubbery and flowers should not be trampled or destroyed, the house itself should not be damaged in the process of placing coal in the bin. (It must be pointed out that where there is improper design of the house and its landscaping and facilities, damage will occur in spite of extreme care taken by the deliveryman.)

Reduce Inconvenience

Ideally, the owner should not be inconvenienced in any way by the fuel delivery. It is especially desirable that the owner should not be bothered by the coal man having to enter either the house or the basement at any time. This can be accomplished only (a) when the bin can be filled without inside trimming, (b) when the owner has unlocked the delivery window previous to the arrival of the fuel, and (c) when the owner has checked and prepared the storage bin for delivery. Although the owner would prefer not to be bothered in any way, he usually will agree to perform chores (b) and (c) above in order to keep the deliveryman out of the house and basement. It is likely that the careful deliveryman will still wish to check the bin to see that it is properly prepared to hold the coal to be delivered.

Size and Frequency of Delivery

The home owner is not concerned primarily with the size of the load which the dealers haul, provided the truck does not damage his property and provided his pocketbook is not penalized for small loads. He will be concerned with the frequency of delivery if every delivery results in the necessity for a general house recleaning. Where this is the case, the consumer will demand that a season's fuel be delivered at

one time. Other consumers will order a full season's supply of fuel because it is satisfying to them to know that they have all their requirements for the winter on hand.

2. From the Solid Fuel Merchant's Standpoint

The merchant will adopt the method of delivery which will best accomplish his two primary objectives, which are (a) consumer satisfaction and (b) economical delivery.

Satisfy the Consumer

Consumer satisfaction can be assured by taking into consideration the home owner's viewpoint as stated above.

Deliver Coal Economically

Economical delivery involves several factors, most important of which are man hours and truck hours per delivery. Any method that will save man hours and truck time at the delivery point will be most satisfactory to the fuel merchant. Perhaps in the future some pneumatic or other mechanical means will be developed which will enable the merchant to deliver solid fuel from the truck at the curb through a flexible tube to the bin. Such a tube could go around corners and up and down inclines and thus completely solve the problem of how to get the coal from the truck to the bin. Until such a device is perfected, deliveries will have to be made with equipment now available.

Generally speaking, it is more economical for the dealer to deliver a season's supply of coal at one time rather than to deliver it at several different times during the year. The saving is made in eliminating the time consumed by the repetition of such items as obtaining the owner's signature on the delivery ticket, opening the delivery chute, and cleaning up after completing delivery.

The dealer can make the large delivery in two ways. He can, for example, make one trip with a 10-ton truck, or he may make four trips with a $2\frac{1}{2}$-ton truck. On the surface, the single delivery with the large truck would appear to be most advantageous, but such is not always the case.

Usually a 10-ton truck is so heavy that the driver cannot bring it up on the owner's driveway for fear of causing damages. Thus, the possibility for a direct mechanical truck-to-bin delivery (for example, by conveyor) is eliminated. In this case some slow manual method (probably by wheelbarrow) must be used to transfer the coal from the truck to the storage bin.

The small $2\frac{1}{2}$-ton truck can use the owner's driveway and by using a conveyor can make a rapid mechanical delivery. It is likely that any savings made by using the larger truck would be offset by the expense of wheeling 10 tons of coal from the curb to the bin.

There is one factor, however, which makes large deliveries more expensive regardless of the size of truck used. Large deliveries mean a large bin, and the large bin means more extensive hand trimming inside the bin in order that it be filled completely.

3. Mutual Objectives

Consideration of the desires of both the home owner and the coal merchant indicates that a coal delivery and storage method which would eliminate hand trimming inside the bin would be beneficial to each. Such an arrangement can be made, and the delivery would go something like this: The owner has previously unlocked the coal chute. The coal deliveryman drives the truck up to the chute (probably on the garage driveway), the driver and his helper unload and arrange the conveyor and feed the coal into the bin. Then they pick up the conveyor, clean up the area, close the window (which locks automatically), and depart--all in the matter of a few minutes.

It is likely that this method would require smaller and more frequent deliveries, but as the cost of labor rises, hand trimming becomes more and more expensive. It is probable that the savings made in fast mechanical deliveries without hand trimming would overcome any losses occasioned by the delivery of smaller amounts of coal. Actually many existing bins are small and will not permit the delivery of more than two or three tons at one filling. Furthermore, the consumer's preference or his pocketbook often limits the quantity of coal ordered per delivery.

In the delivery described, (1) the coal chute was opened for the deliveryman, (2) the bin did not require hand trimming. This means it is not necessary for the deliveryman to enter the basement. This eliminates one of the major considerations in the design and location of the basement stair. The house designer may now place his stair without consideration of the coal man's entrance into the house. It is believed that this factor, plus the probable saving in delivery cost to the dealer, warrants study of the use of the small bin and frequent delivery versus the large storage bin. Actually "frequent delivery" for the small properly built and insulated home will probably mean no more than one or two additional deliveries after the original filling of the bin.

B. PRESENT PRACTICE

1. Procedure

The normal procedure in present day coal deliveries is something like this: The consumer calls the coal merchant and orders a certain quantity of coal. If he is a regular customer of this coal merchant, the merchant knows what type of delivery is to be made and the truck is loaded accordingly. The more progressive merchants will know from their records whether the quantity of fuel ordered is somewhere within reason. When the driver arrives with the load, his first task is to get his delivery ticket signed. If the owner is not at home, no delivery will be made unless previous arrangements have been made for such a case. When the delivery ticket is signed, the next job is to get the fuel-delivery window open. Most customers expect the coal deliverer to do this job as it is usually necessary to go into the coal bin and climb over any remaining coal to the delivery window. In some cases, however, the owner himself will open this window, in order to do away with as much tracking through the basement as possible.

Progressive merchants will make provisions for keeping the area outside the coal window clean by placing a tarpaulin on the ground. During the course of the delivery, it will probably be necessary for the coal hiker to enter the bin for the purpose of trimming back the fuel which has been put into the bin,and filling the far corners. Most coal deliverymen will again go through the basement to get to the bin although some will crawl through the coal-delivery window. When the delivery is completed, the coal hiker cleans up any spilled coal and then closes the window. Most windows are designed so that they are locked upon closing. If this has been a wheel-in delivery, the wheelbarrow will be left at the house and later picked up by a company truck. Often times the house owner is asked to look out for the wheelbarrow until a man with the proper credentials arrives to pick it up.

2. Type of Delivery from Truck to House

There are, at present, three basic methods (each with variations) used for moving coal from the truck to the house--

(a) Direct truck-to-bin
(b) Wheel-in
(c) Bag and carry.

(a) Direct Truck-to-Bin

Direct truck-to-bin deliveries can be used where the truck can approach the bin closely. In the direct dump type of delivery, the arrangement is such that the fuel may be dumped directly from the truck through a manhole into the bin.

In another variation of the truck-to-bin delivery, the fuel may be placed in the bin by means of a conveyor or motor trimmer. These conveyors are designed primarily to handle stoker-size coal, but are also used for nut, egg, and stove-size coal. Some dealers use them for larger lump coal, also. These small

portable conveyors are standardized in lengths of 14 and 20 feet and weigh from about 125 to 275 pounds. The lighter weight units are designed so that one man can handle them. Some conveyors have motors which may be detached to make handling easier. Normally, however, conveyor-equipped trucks are sent out with two men aboard, although since labor has been difficult to find, some merchants have sent out trucks with only one man aboard. In some areas, union organizations require that two men be on the truck whenever a conveyor is to be used, and also specify that the conveyors may not be used to move the coal for a distance greater than 14 feet. Conveyor or motor trimmer delivery is most adaptable where the coal-delivery window is located on a drive which is accessible to the coal-delivery truck, or where the house is placed close to the street or alley and delivery may be made directly from the curb. Conveyors can be used to deliver fuel in to a high window, as they will carry fuel upward at a considerable angle, varying with the size, moisture content, treatment, and characteristics of the fuel.

Another truck-to-bin type of delivery may be accomplished by using a chute. The coal may be shoveled over the side of the truck into the chute, or may be delivered by means of a chute directly from a high-lift truck.

(b) Wheel-in

The design of many homes is such that truck-to-bin deliveries are not possible, and it is necessary to bring the coal in by wheelbarrow. In this type of delivery the coal is usually dumped in the street or alley and a hiker and his wheelbarrow are left behind to complete the job, while the driver returns the truck to the yard. Occasionally, high-lift trucks are used and are left at the house during the delivery and the wheelbarrows are filled directly from the truck.

(c) Bag and Carry

When the house is so arranged, and the fuel-storage bin so located, that direct delivery, or delivery by means of a wheelbarrow, is impossible, bag and carry type of delivery must be used. The coal may be dumped in the street or alley and the hiker then bags the coal at the residence and completes the delivery. In other cases, the coal may be bagged at the retail dealer's yard, loaded on the truck, transported to the house, and then carried from the truck to the bin. Bag and carry deliveries are never made as a matter of choice; they are made only when poor planning of homes requires such delivery.

3. Quantity of Delivery

The size of the normal truck load of fuel varies considerably with the locality. In Chicago proper, fuel merchants receive a premium for deliveries less than 4 tons; they prefer to deliver a full load of 10 tons. Many dwellings in this area are multi-family and require these larger quantities of fuel. Few deliveries in Chicago are made by means of the home owner's driveway; deliveries are predominantly wheel-in or bag and carry.

In smaller urban localities where single family dwellings predominate, smaller trucks and smaller deliveries are used. Average truck loads are from 2 to 3 tons. Such loads can be driven over city sidewalks and up private driveways without danger of damaging either. If large quantities of fuel are ordered, the delivery is made in several small loads rather than one large load. Driveways cannot be utilized with the heavier loads.

4. Fuel-Delivery Chutes

At the present time there are several types of coal-delivery windows or chutes in use in small homes. A common type is the malleable iron or pressed steel foundation-wall chute. This chute is set in the vertical foundation wall and is hinged at the top, thus offering some protection to the house wall above during delivery. (See figure 4 on page 12.) The two common sizes approximate 22 inches high by 32 inches wide and 18 inches high by 24 inches wide. They are made to fit wall thicknesses of 8 inches, 12 inches, and 16 inches. The chute with the larger opening is usually made for walls thicker than 8 inches and thus does not fit residential construction. Some of these chutes have glass panels in the doors.

In some houses, ordinary steel or wood sashes are used in the foundation walls for coal delivery. At the present time, steel sashes are hinged at the top or bottom and are standardized in the following sizes--

2'-8 7/8" wide by 1'-2 3/4" high
2'-8 7/8" wide by 1'-6 3/4" high
2'-8 7/8" wide by 1'-10 3/4" high.

Wood sashes vary considerably in size.

Grade-line chutes are manufactured to be used in houses which are set close to the ground with little foundation wall exposed. The door and opening of grade-line chutes are on the level with the ground outside and the opening is in a horizontal plane.

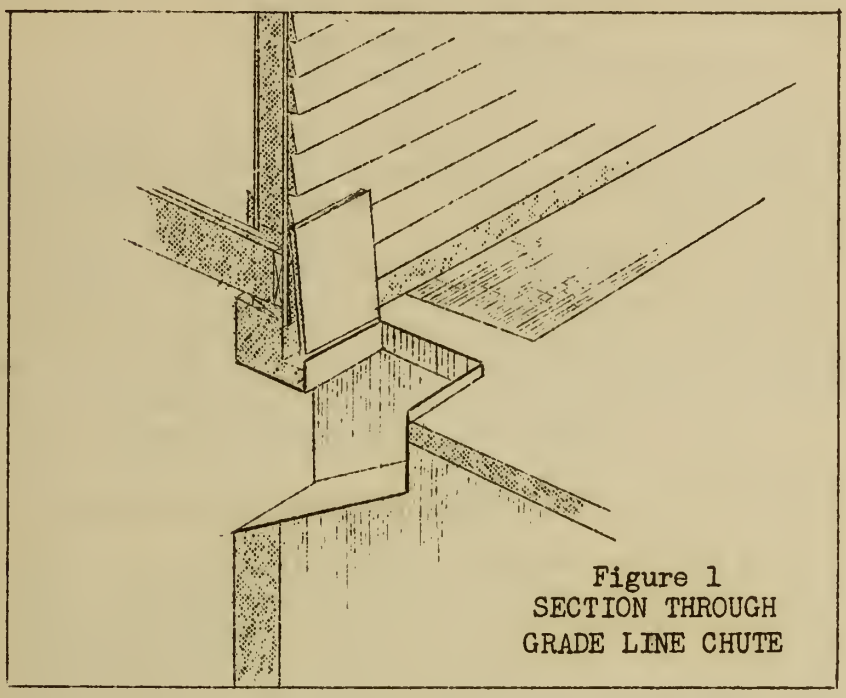
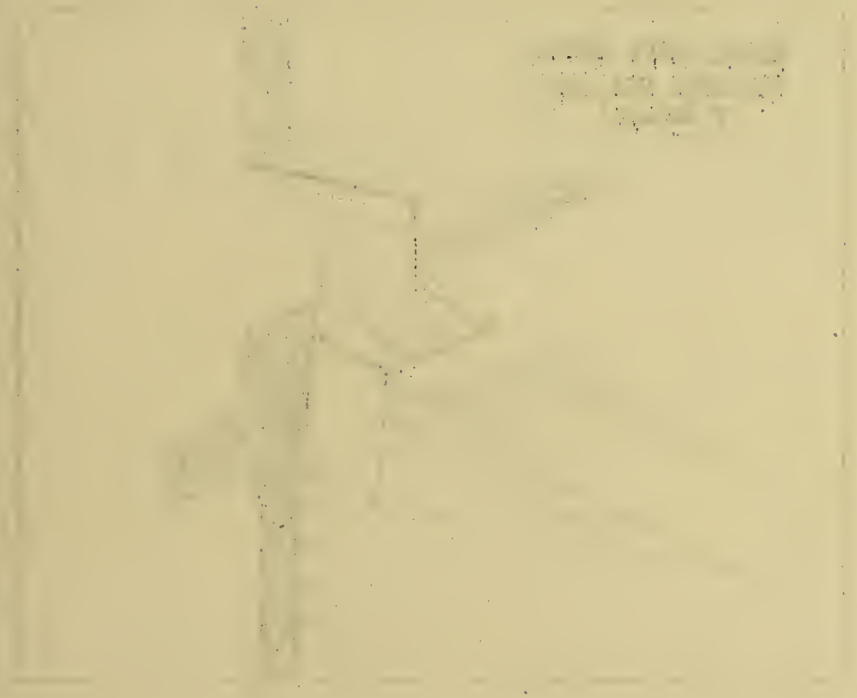


Figure 1
SECTION THROUGH
GRADE LINE CHUTE

Occasionally a window or coal chute in the basement foundation wall is placed in an areaway and coal deliveries are made through the window.



C. RECOMMENDATIONS

1. Type of Delivery

It is recommended that houses be planned so that direct truck-to-bin deliveries can be made. Acceptable forms of truck-to-bin delivery are:

(a) By chute (without hand shoveling)
(b) By direct dumping
(c) By conveyor or motor trimmer.

Consideration of the viewpoints of both the home owner and the solid fuel merchant indicates the necessity of standardizing some clean, economical, and fast method of delivery. To accomplish cleanliness, the coal should be handled as little as possible; to attain speed and economy, manual labor should be reduced to a minimum. It is obvious that bag and carry deliveries or wheel-in deliveries cannot meet these specifications. Both are slow and likely to be messy. The bag and carry method is primitive and should be completely eliminated. Wheel-in deliveries are better but should be considered only when improved methods cannot be used.

(a) Recommended Delivery--by chute (without hand shoveling)

When the coal may be dumped without handling from the truck into a chute, chuting is an acceptable method of delivery. Chuting delivery, however, should not be considered if it is necessary for the coal hiker to shovel coal over the side of the truck into the chute, although this manual method is preferable to either bag and carry or wheel-in delivery. Chuting deliveries can be made either through the foundation-wall type of chute or into a manhole, provided an adequate slope can be obtained for the chute.

The mechanical conveyor type of delivery will probably replace delivery by chute as the conveyor will work in similar circumstances to the chute and is much more satisfactory.

(b) Recommended Delivery--by direct dumping

This is the simplest method of truck-to-bin delivery; however, the expense involved in special bin construction usually rules out this type of delivery for the small house.

The best arrangement for dump delivery is for the truck to dump directly in a manhole located in the driveway of the house. Dumping into a manhole inside the garage is not acceptable. The garage is normally too small to accommodate the raised truck. In order to fill the bin as completely as possible, the manhole should be centrally located.

In certain unusual occasions it may be possible to dump directly into a bin which is partially under the house. Special provision must be made in the driveway design and location in this case. The driveway must be planned so that the truck may be backed up to the wall of the building perpendicularly. (See figure 2.) For dumping, the delivery opening should be in the horizontal plane.

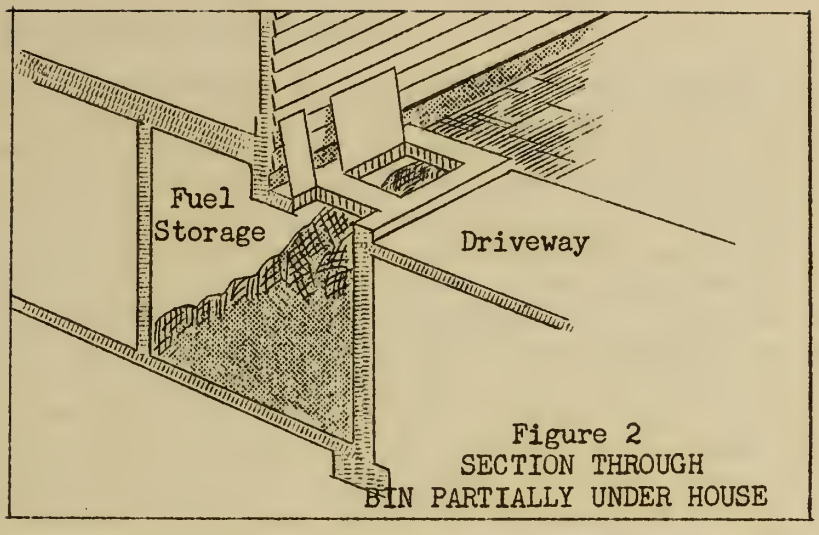


Figure 2
SECTION THROUGH
BIN PARTIALLY UNDER HOUSE

(c) Recommended Delivery--by conveyor or motor trimmer

This type of delivery is the best available under present circumstances. (See figure 3.) Little special construction is required for this system to be used in the small home. Where conveyors are to be used to place coal in a basement bin, the delivery window should be placed in the foundation wall of the house. Conveyors have a distinct additional advantage in that they may be used to throw the coal farther into the bin, thereby eliminating a part of the hand-trimming job. It is possible that the necessity for hand trimming may be completely eliminated, if the bin is small and designed with this idea in mind.

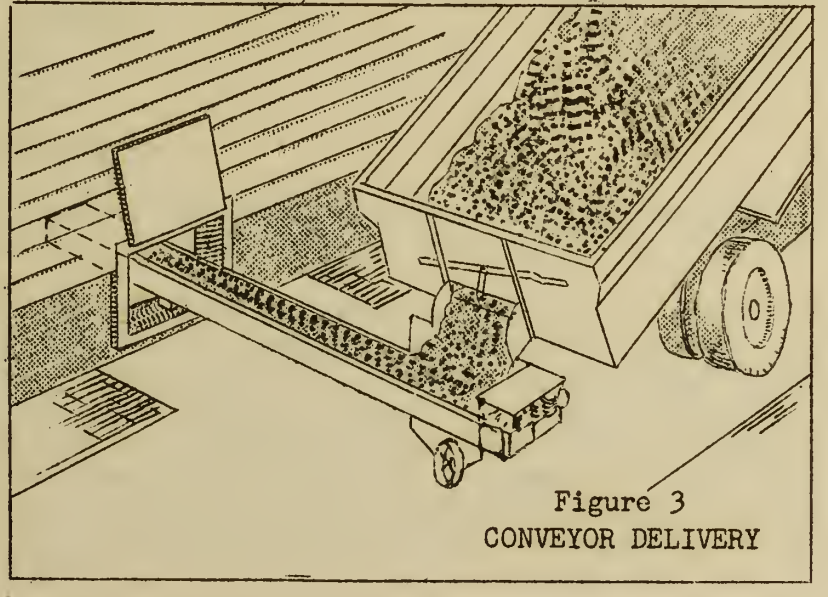
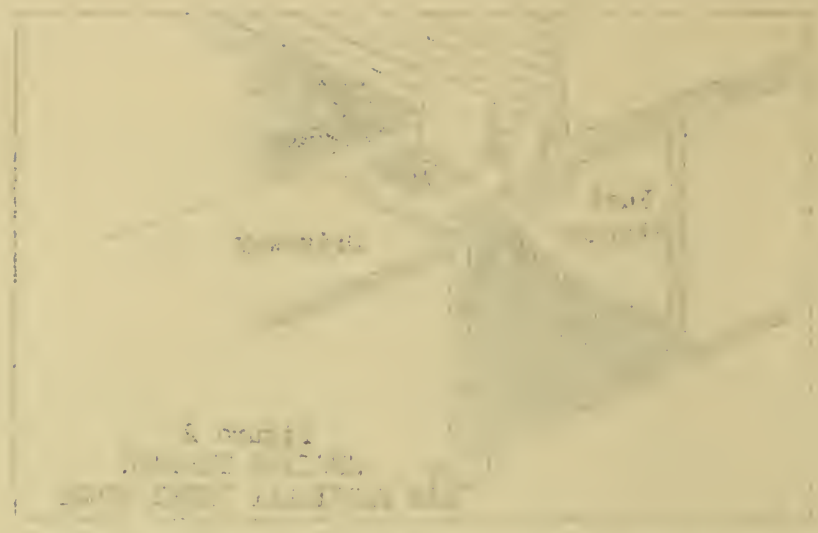


Figure 3
CONVEYOR DELIVERY

Conveyor deliveries can be made where the delivery opening is in a horizontal plane (such as a manhole), but the advantage of delivering farther into the bin is lost. Delivery by conveyor or motor trimmer will probably be used more extensively in the future, as it is one of the cleanest and fastest methods of placing coal in the bin.



Alternate Delivery--by wheelbarrow

Where there is no driveway, or the driveway is so located that direct truck-to-bin delivery of the recommended types is impossible, provision must be made for delivery by wheelbarrow. There should be a paved area where the coal may be dumped before the wheeling process begins. This area could be the apron of the garage. Provision should be made to have a paved wheeling way from the dumping area to the coal-delivery chute. This route should be as straight as possible and not traverse any steps. Under the best circumstances the walk or pavement should lead directly to the coal-delivery chute without requiring a turn immediately before dumping the coal into the window. Where this is not possible, adequate room must be allowed for the turning of the wheelbarrow, and for backing away from the coal chute. The coal chute itself must be of adequate size to accommodate the spout of the wheelbarrow.

2. Quantity of Delivery

In recommending truck-to-bin deliveries, the size of the load is automatically limited. The majority of truck to bin deliveries will be made by using the owner's driveway for access to the bin, and the quantity of the delivery will be determined by the strength of the driveway. Trucks will be limited to those sizes which can cross city sidewalks and private driveways without doing damage. The capacity of such trucks is normally under four tons. If larger deliveries are required, multiple trips will have to be made.

In some home deliveries, small trucks have certain inherent advantages over larger trucks in addition to the above; for example, they are much more maneuverable, and are not as likely to strike low hanging trees along the driveway.

3. Fuel-Delivery Chute

(a) Foundation-Wall Type

The foundation-type coal chute is recommended for the conveyor delivery when the fuel bin is under the house.

It is recommended that the foundation-wall type of fuel-delivery chute be designed to be a modular unit which will fit in a standard concrete block wall opening. The masonry opening should be 24 inches high and 24 or 32 inches wide. (See figure 4 next page.) It is recognized that smaller windows, especially in height, are architecturally desirable, but it is necessary that the windows be as large as specified in order that proper delivery can be made. Windows of less height can be used in emergency for conveyor deliveries.

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Chicago coal merchants recommend that coal windows be a minimum of 30 inches by 30 inches. Their purpose in this recommendation is to allow an opening large enough for the coal hiker to enter the bin. Openings of this larger size are especially desirable in apartment and multi-family dwellings where a larger fuel supply is required.

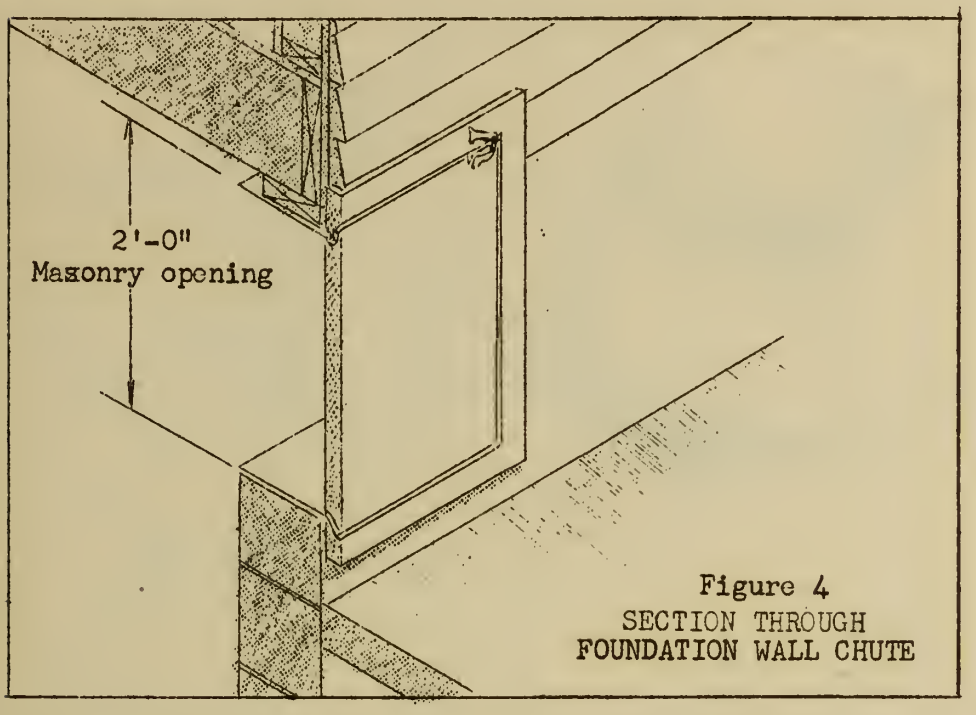

Figure 4
SECTION THROUGH
FOUNDATION WALL CHUTE

Fuel merchants in smaller communities indicate that an opening 24 inches by 24 inches would be satisfactory. This opening allows adequate room for delivery and can be used by the hiker as an entry to the bin if necessary. In most cases, however, the hiker will probably enter the bin through the basement if there is a grade entrance.

Chutes should be manufactured of metal and designed to afford protection to the surrounding masonry and frame walls of the house. There should be no glass in the chute door. The throat of the chute should be designed to fit the thickness of the ordinary basement wall, which is normally 8 inches in the frame house, 10 inches for brick veneer houses, and 8, 10, or 12 inches in solid and cavity masonry wall houses. The bottom portion of the throat should not slope. The window catch should lock automatically upon closing, but be designed so that a chain pull can be attached so that the window can be unlatched from the basement without going into the coal bin. (See footnote on page 19.)

(b) Grading for Foundation Coal-Delivery Chute

Every small home of today is enhanced in its setting by being placed close to the ground. Federal Housing Administration regulations specify that the lowest line of any wood construction must not be less than eight inches above grade. This means that eight inches of the foundation wall will be exposed. This eight inches, plus the thickness of the floor construction, will make the finish floor of the house about 18 to 20 inches above the grade line.

However, for suitable installation of the coal-delivery window, the foundation wall should be exposed about 28 inches rather than 8 inches. The requirement of 28 inches allows the installation of a delivery chute 24 inches high and gives a 4-inch clearance to maintain drainage.

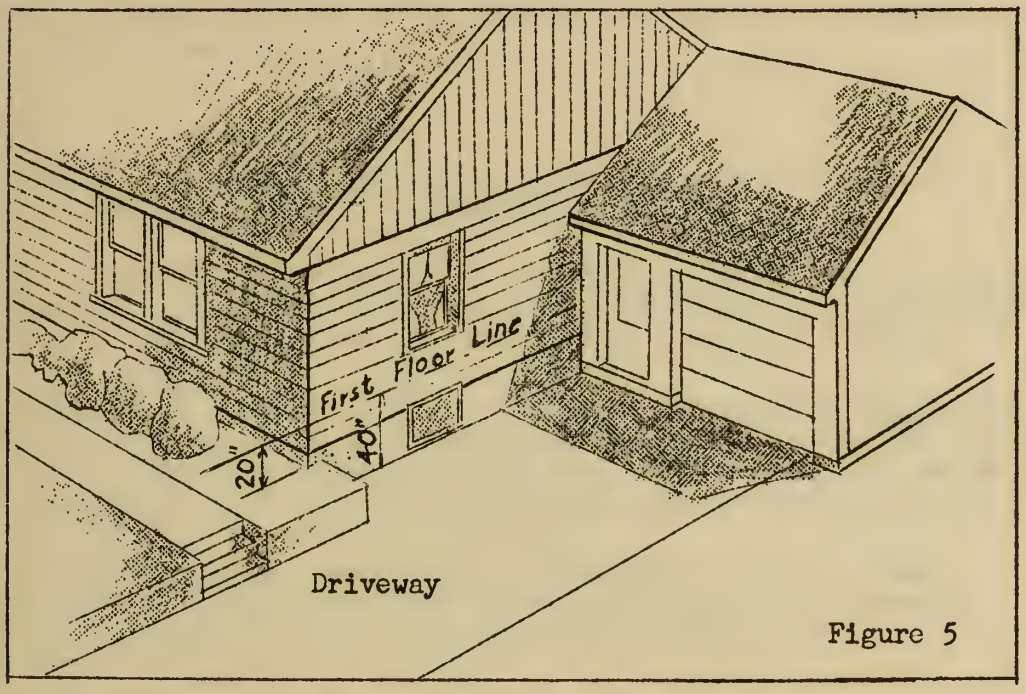

Figure 5

It is obvious that the requirements for esthetic appeal and practical use are in disagreement and that some compromise must be reached. A common practice is to raise the house so that the first floor level is about 40 inches above the driveway. The driveway is usually established at original grade level or thereabouts. This allows the coal chute to be placed properly on the driveway. At the same time, the grade line of the front yard may be established as suitable for the best design of the house, the material excavated from the basement being used to fill for this grade. (See figure 5.) This arrangement has advantages in addition to providing for the fuel-delivery problem. Basement excavation is 20 inches less deep, and basement windows on the rear of the house do not require areaways.

It is desirable to locate the service entry on the driveway where it is convenient to the garage. When it is located on the driveway, constructed as advised above, it is recommended that the grade entrance be located at a level about one step above the driveway. This means that the grade entrance landing will be about four steps below the first floor.

SOLID FUEL STORAGE

A. OBJECTIVES IN BIN DESIGN AND LOCATION

Ultimate objective is to provide economical and clean storage of an adequate amount of fuel in such a manner and at such a location that the fuel can be used with maximum convenience.

1. Convenience

Bins should be located to facilitate proper delivery; they should also be located for convenience to the heating unit.

Bins should be designed so that they are easy to fill. It is desirable, where possible, to make it possible to fill bins with no inside trimming, so that it is unnecessary for the deliveryman to enter the house.

Bins should be designed so that it is easy to get the coal out of the bin. Bins should be designed so that one is not required to enter the bin to get fuel excepting in the case of emergency. The largest portion of thefuel stored should flow to a shovel box or to the worm of a bin-feed stoker.

Infrequent deliveries are desirable; one delivery a year is ideal, provided the bin required for this is not so large that it creates inconveniences in getting the fuel in and out of the bin.

2. Cleanliness

Bins should be built so that they are dust tight. When correctly designed, it should not be necessary for anyone to enter the bin, thus eliminating the tracking of coal particles. To implement this, shovel boxes should be provided in bins where shovels are to be used.

3. Economy

Bins should be built so that they serve their purpose adequately, but are inexpensive to construct. In selecting a location for the fuel bin, inexpensive space should be used wherever possible. The type and shape of bin that will use the space occupied to the best advantage, is needed. Bins should be of the smallest size that will provide an adequate amount of fuel with a minimum number of deliveries.

B. FACTORS IN BIN LOCATION

1. Location of Bin for Delivery

The primary consideration in the location of the bin is to facilitate delivery of solid fuel. The discussion of delivery problems showed the most logical type of delivery to be some form of direct truck-to-bin delivery, and that this delivery would probably be handled by means of the owner's driveway.

(a) Locations and Arrangements for Dumping Delivery

Dumping delivery requires a horizontal opening in the top of the bin.

Excellent--

(1) Bin under driveway--manhole in driveway.

Provision must be made to eliminate all water which might enter the bin either through seepage or on the coal when delivered. If water is not eliminated, there is danger of the coal freezing.

Suitable--

(2) Bin partially under house, requires special design consideration. The driveway must be planned so that truck may back up to bin perpendicularly. (See figure 2 on page 10.)

Not Satisfactory--

(3) Bin under garage--trucks cannot raise dump body.

(b) Locations and Arrangements for Conveyor Delivery

Conveyor delivery requires a vertical opening in the side of the bin (at the top) for best results. Conveyors can be used for bins with manhole openings, but the advantage of placing the coal farther in the bin is lost.

Excellent--

(1) Bin in basement, driveway parallel to basement wall--vertical opening. (See figure 3, page 10.)

(2) Bin under porch, driveway parallel to porch foundation wall--vertical opening.

(3) Bin at first floor level or slightly below, driveway perpendicular to outside bin wall--vertical opening. Opening height must be adjusted to accommodate the conveyor. (See figure on next page.)

Suitable--

(4) Bin on first floor level or slightly below, driveway parallel to outside bin wall--vertical opening. This scheme can be as satisfactory as (3) if proper clearances are arranged for using conveyor perpendicular to the length of the driveway.

(5) Bin under garage--horizontal opening.

Opening should be provided with a curb and tight covering to prevent gasoline fumes from entering storage bin. *

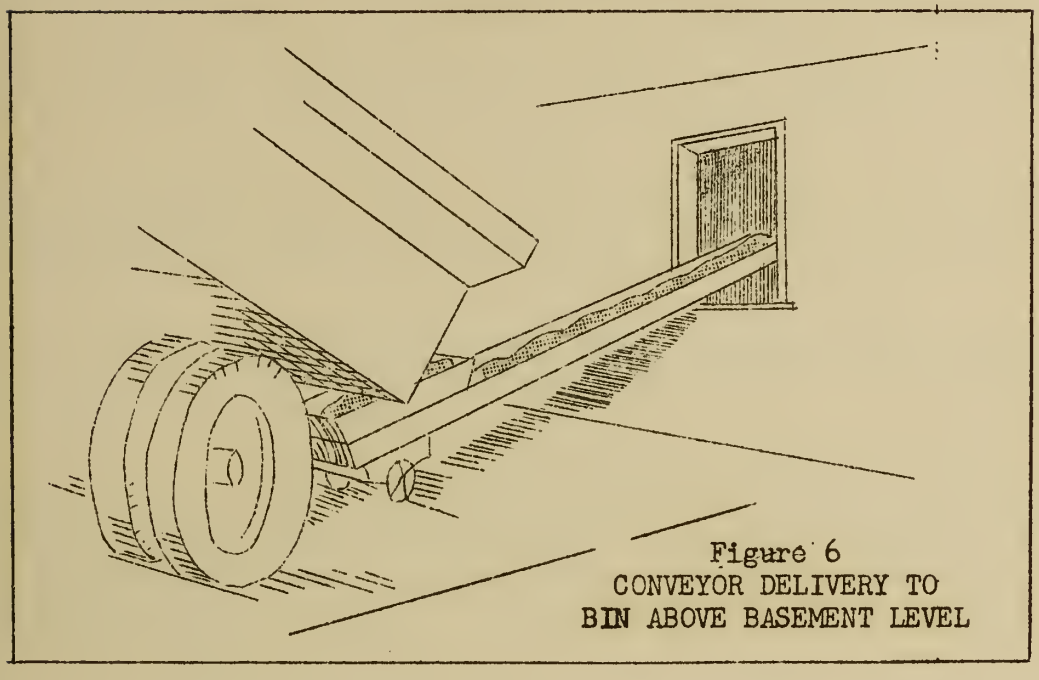

Figure 6
CONVEYOR DELIVERY TO
BIN ABOVE BASEMENT LEVEL

(6) Bin partially under house--horizontal opening.

(c) Locations and Arrangements for Delivery by Chute

Delivery by chute is best when the coal can be dumped into the chute directly from the truck. Either vertical or horizontal openings are suitable if an adequate angle can be otained for the chute. Any location is satisfactory which meets these requirements. The same requirements apply when the chute is hung over the side of the truck and the coal is shoveled into the chute by hand.

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* Section 1305, paragraph 2, of the "Building Code" recommended by the National Board of Fire Underwriters, New York, New York (1943 edition), referring to garages not exceeding six hundred square feet in area attached to residences, states in part that, "Openings from the building into garage shall be restricted to a single doorway; such opening shall be provided with a flush type wooden door of not less than one and three-quarter inches nominal thickness equipped with an approved self-closing device." The paragraph also states that, "There shall be no pit in any floor." These provisions would seem to eliminate the possibility of constructing a bin under the garage.

2. Location of Bin for Economy in Construction

The most economical location of the bin is in the basement, using as much of the available house foundation walls as possible. Location in a corner will probably be most feasible, necessitating the construction of only two walls.

Bins located under porches and garages will be more expensive as the footing walls have to be extended to the depth of the basement, or nearly so. The amount of this extension will depend upon the usual depth to which footings are built for frost protection in the locality. The slab over these bins will have to be reinforced--the porch slab to carry foot traffic, the garage slab to carry an automobile.

Careful provision must be made to provide tight covers for horizontal openings in garage floors. This is to prevent the entrance of water, oil, gasoline, and gasoline fumes into the bin below. The opening should be surrounded with a curb to prevent these leakages.

Bins built under driveways will be still more expensive, as more wall must be constructed, heavier reinforcement is required, and provisions must be made for excluding water.

Bins located on the first floor will be the most expensive of all, primarily because in this location they will occupy an area that could be used for living space. As long as the bin is in the basement, the space occupied by the bin is not critical, as normally basement space is only suitable for storage and utility spaces, and for some limited recreational areas.

If, however, the bin and firing room are to be located on the first floor, and they are to occupy an area that could be used for living space, only a small space can be allotted to them. First floor space is more expensive to construct, and in many cases, the addition of bin and firing areas on the first floor is likely to cause need for a larger lot.

In farm homes, the problem of drainage often eliminates the possibility of a basement. Since there is usually plenty of land available, the farm home may have the heater room and fuel storage on the first floor without the penalty of crowding the living space of the house.

As lots grow larger to meet the demand of the public, this problem will become less critical. A majority of home builders have already come to accept the desirability of sacrificing 10 feet of lot width and 200 square feet of space almost in the house itself, in order to gain the convenience of having their automobile in an attached garage.

3. Location and Design of Bin for Cleanliness

Modern treatment of coal makes dust less of a problem than formerly. Nevertheless, all bins should be dust tight. Location in a corner of a basement makes this more easily done. Other advantageous locations from the point of isolation and dustlessness are under the porch, under the garage, and under the driveway.

Bins built of masonry construction are the most dust tight, but are more expensive than bins built of wood construction. Wood bins should be built of sheet material, such as plywood, or with matched lumber.

To eliminate tracking of coal particles, bins should not be entered, excepting in emergency. Shovel boxes should be provided to facilitate withdrawal of fuel from all bins (excepting bins used with bin-feed stokers).

Access doors to bins should fit well.

4. Location of Bin in Connection with Firing Room

The coal bin cannot be located without consideration of its relation to the heating unit and the basement stair. The location of these three elements are interdependent and final location of each element cannot be determined without study of their interrelationship.

(a) Convenience to Heating Unit

The coal bin should be placed so that firing of the boiler or furnace is convenient. Where hand firing is to be used, the distance between the shovel box of the bin and the firing door should be only a few steps.

Where a hopper-feed stoker is used, the hopper should be located near the shovel boxes of the bin in such a manner that it is only necessary to turn a quarter or half circle to shovel into the hopper.

The ideal arrangement for the bin-feed stoker is a straight line plan. Certain stoker manufacturers provide for screw conveyor extensions which may be attached to the stoker and heating unit at almost any angle, but the straight line arrangement is most economical.

(b) Convenience to Basement Stair

When a large coal bin is filled annually or semi-annually it may be necessary for the coalman to have access to the bin in order to enable him to do a complete job of filling the bin. The best arrangement for this is to locate the bin and stair in such a relationship as to allow easy access to bin from the outside, thus allowing the coalman to perform his work without tracking through the rest of the house.

C. FACTORS IN BIN DESIGN--FORM OF BIN SPACE

1. Principles

Basic principles to be used in the selection of the form of the bin--

The bin should be designed to provide accessible storage for the fuel to be used during the heating season. Accessible storage is fuel stored so that it flows automatically from the bin to a shovel box or to the worm conveyor of a bin-feed stoker. The bin may be large enough to hold a full season's supply at one time, or it may require replenishing during the season. Whether the bin is filled only once or a number of times, it should be designed so that all of the required fuel will flow to the worm of the bin-feed stoker or to the shovel boxes of the bin.

When the bin is to be filled more than once a year, it should be designed so that it can be refilled while at least ½ ton of accessible fuel remains in the bin. This carryover supply should be part of the regular season's supply.

Inaccessible or dead storage is fuel stored in the bin in such a position that it does not flow to a bin opening of its own accord. Inacessible storage can be reached only by entering the bin. A minimum of approximately ½ ton of inaccessible storage is desirable in every bin to serve as emergency storage. If a bin is completely self-emptying, with all the fuel stored flowing automatically to the bin opening, it is easy for the fireman to forget to check his supply of fuel, and find himself out of fuel without forewarning. The emergency supply will enable him to keep the home warm while waiting for delivery.

It is important that the emergency supply be in excess of the season's requirements and be part of the dead storage, in order that it will actually function as a reserve and not be used inadvertently along with the other fuel stored. A completely self-emptying bin does not provide space for emergency storage.*

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*Representatives of the coke industry recommend that bins be designed to be completely self-emptying. This recommendation is based on the premise that neither owner nor the fuel deliveryman should enter the bin at any time. Experience has shown that as long as some fuel remains, even if it is inacessible and does not flow to a shovel box, the home owner is likely to walk into the bin to get this fuel rather than to order more. There is much to be said for providing self-emptying bins, as more fuel merchants are following the degree day figures and are able to predict when the home owner will need fuel. These merchants would like to be able to deliver fuel at any time they believed the owner needed fuel. In this connection, they would prefer a fuel-delivery chute which could be opened from the outside at all times regardless of whether or not the owner was home.

Another objection to providing dead storage is that experience has shown that fuel that lies in the dead storage area of a bin for successive years is likely to serve as a collector for dust and dirt, and when a new delivery of fuel is made, this dust may be stirred up, thus causing the dealer to be blamed for deliverying dirty fuel.

2. Types of Bins

(a) Flat-bottom bin
(b) Hopper-bottom bin
(c) Sloping-bottom bin

(a) Flat-bottom Bins

The flat bottom bin has the advantage of giving maximum storage of fuel for a given floor area. It is also the type of bin which is most inexpensive to construct. A certain amount of the coal in every flat-bottom bin can be classified as accessible storage; that is, the fuel flows by gravity to the door, shovel box, or to the worm of the bin-feed stoker. Also, in every flat-bottom bin (except the smallest) a certain amount of the fuel does not flow from the corners. This fuel must be classed as inaccessible storage. As the depth of the bin from front to back is enlarged, the ratio of accessible to inaccessible storage decreases, until finally a point is reached at which further enlarging of the bin will not increase the amount of fuel which will flow to the openings or to the stoker worm.

Some bins have been constructed with the idea of eliminating all, or nearly all, of the inaccessible space in the bins. This can be done by building bins with hopper bottoms or sloping bottoms.

(b) Hopper-bottom Bins

Hopper-bottom bins are used primarily in connection with bin-feed stokers and are constructed in a funnel-like shape with four sloping sections forming the bottom of the bin. An opening in the center of the bottom of the bin allows the fuel to flow by gravity to the worm of the bin-feed stoker below. The lowest portion of the hopper, the opening, is usually a foot or so above the basement floor level, and rests on a wooden or metal form which directs the flow of the coal to the stoker-feed worm.

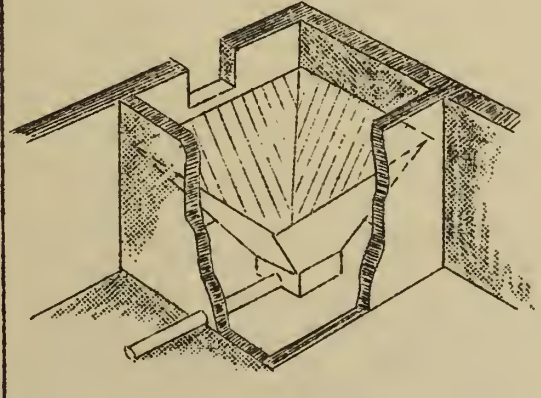
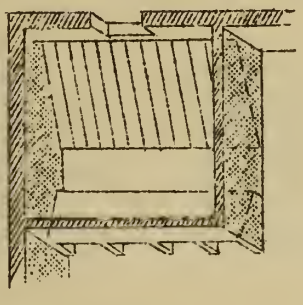


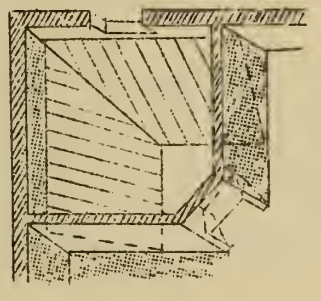
Figure 7
HOPPER-BOTTOM BIN

(c) Sloping-bottom Bins

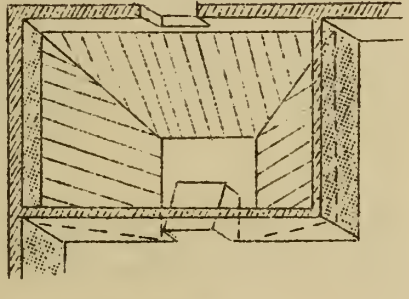
Sloping-bottom bins may be built with one, two, or three sloping segments forming the bottom. The selection of the variation depends upon the location and size of the bin and upon its use--whether it is intended for use with a bin-feed stoker, or for hand shoveling. Below are shown three variations of the sloping-bottom bin.



Single Slope
(Type A Bin)



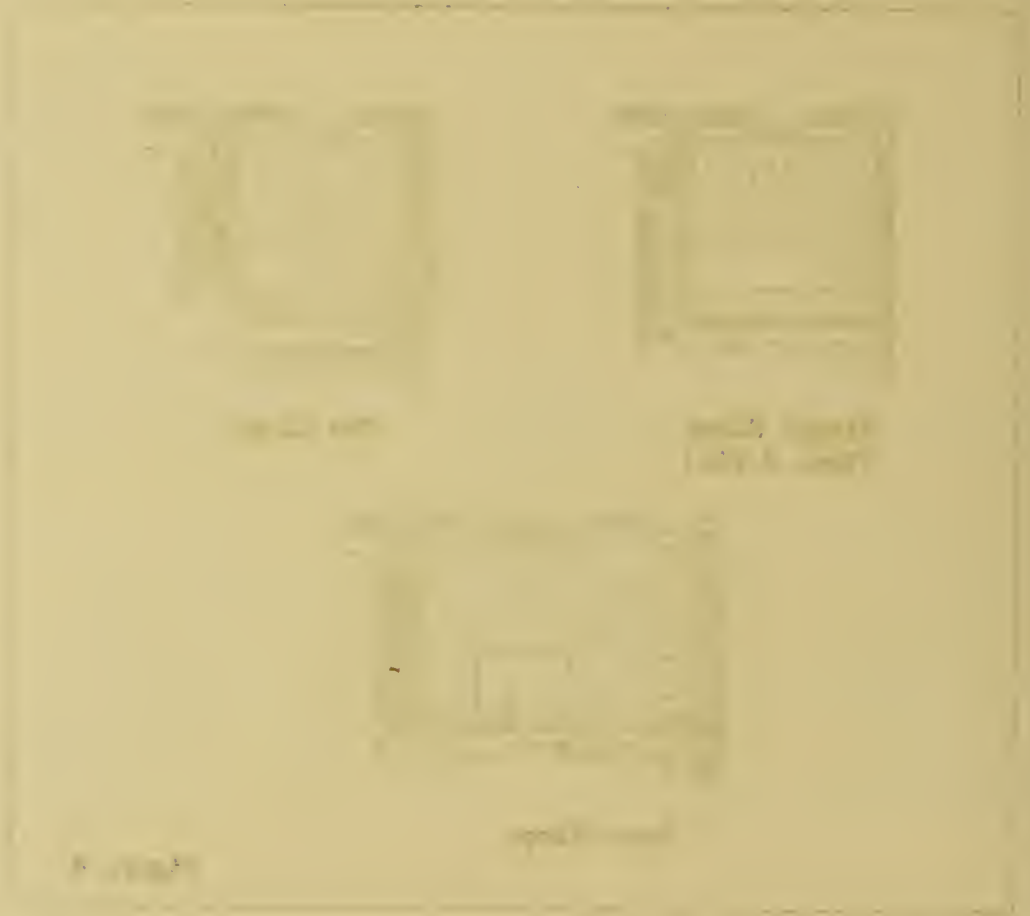
Two Slope



Three Slope

Figure 8

Bins with special bottom construction are advantageous in that they are designed so that a greater percentage of the fuel stored flows to the point where it is needed. On the other hand, these bins provide less total storage per square foot than the flat-bottom bins. In the flat-bottom bin the fuel forms its own sloping sides; the angle of these sides is equal to angle of repose of coal on coal. Since the angle of slope of coal on metal (and in some cases, of coal on wood) is less than the slope of coal on coal, it is possible to obtain slightly more accessible storage in a given area by providing a sloping bottom of some such material. In the sloping-bottom bin, the inaccessible portions of the bin are occupied by the sloping-bottom construction rather than by coal. In many cases it is less expensive to form the sloping bottoms with coal than to build the special bottoms of lumber or masonry. Also, the extra fuel can serve as additional emergency storage.



3. Form of Bin for Hand-fired Heaters and Hopper Stokers

In those homes where the heating unit will be hand fired or fired by a hopper-feed stoker, the fireman will handle the fuel with a shovel. Basically there are two types of bins which are suitable for this type of use--

Type A--shovel boxes across entire width of bin
Type B--a single shovel box centrally located.

Either of these bins may have sloping bottoms, if desired. When a sloping bottom is to be used, specify a single-slope bottom for type A bins. For type B, a three-slope bottom is commonly used as it eliminates more of the dead storage. Single or two-slope bottoms may be used with type B bins, also.

The type A bin is the most efficient in that the greatest accessible storage for a given floor space can be obtained. However, when wide bins are used, there is the problem of carrying fuel in a shovel from the more remote shovel boxes to the firing door of the heating unit, without spillage. This can be overcome with the use of a proper shovel and reasonable care. The efficiency of the type A bin makes it the preferred type.*

The type B bin is not efficient. When only a single shovel box is used, too much fuel is inaccessible in the bin. The one advantage of a type B bin is that the single shovel box may be conveniently located to the heater.

A chart, entitled "Capacities of Type A Bins," is shown on the following page. The calculations of the capacities of the bins are based on the following assumptions:

(a) angle of repose, coal on coal, 45 degrees
(b) coal stored level to five feet high
(c) 1 ton of bituminous coal occupies 45 cubic feet.

From this chart, certain conclusions can be drawn, as follows:

(1) The bin 5'-0" deep (front to back) is the most efficient in that it has more accessible coal storage per square foot than any other. This depth of bin is not recommended as it does not provide enough inaccessible emergency storage.

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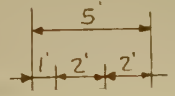
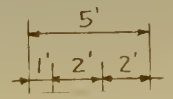
*Representatives of the coke industries recommend the single shovel box as the ideal.

4. [illegible]

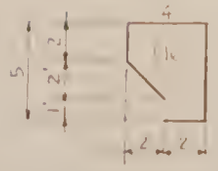
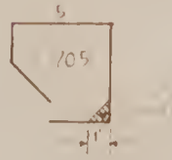
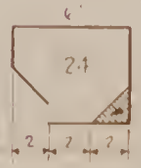
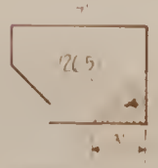
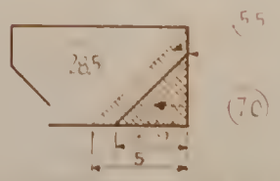
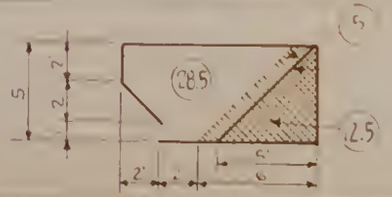
[illegible] [illegible] [illegible] [


5'
1'
2'
2'


5'
1'
2'
2'

CAPACITIES OF TYPE A BINS

for Bituminous Coal - 1 ton occupies 45 cubic feet

CROSS SECTION OF BIN (FRONT TO BACK)	TYPE OF STORAGE	ACCESSIBLE STORAGE tons per sq. ft.	WIDTH ACROSS SHOVEL BOX FRONT									
			4'-0"		6'-0"		8'-0"		10'-0"		12'-0"		14'-0"	
			VOL	TON	VOL	TON	VOL	TON	VOL	TON	VOL	TON	VOL	TON
 Figures in circles are volumes (cu.ft.) for one foot widths	ACCESSIBLE STORAGE INACCESSIBLE STORAGE (Without sloping bottom)	.0888	64 0	1.4 -	96 0	2.1 -	128 0	2.8 -	160 0	3.5 -	192 0	4.2 -	208 0	4.6 -
 Shaded portions represent inaccessible storage	ACCESSIBLE STORAGE INACCESSIBLE STORAGE (Without sloping bottom)	.0911	82 2	1.8 -	123 3	2.7 -	164 4	3.6 -	205 5	4.5 .1	246 6	5.4 .1	287 7	6.3 .1
	ACCESSIBLE STORAGE INACCESSIBLE STORAGE (Without sloping bottom)	.0888	96 8	2.1 .1	144 12	3.2 .2	192 16	4.2 .3	240 20	5.3 .4	288 24	6.4 .5	336 28	7.4 .6
	ACCESSIBLE STORAGE INACCESSIBLE STORAGE (Without sloping bottom)	.0841	106 18	2.3 .4	159 27	3.5 .6	212 36	4.7 .8	265 45	5.8 1.0	318 54	7.0 1.2	371 63	8.2 1.4
Sloping bottom	ACCESSIBLE STORAGE INACCESSIBLE STORAGE (Without sloping bottom) (With sloping bottom)	.0777	112 32 -	2.4 .7 -	168 48 24	3.7 1.0 .5	224 64 32	4.9 1.4 .7	280 80 40	6.2 1.7 .8	336 96 48	7.4 2.1 1.0	392 112 56	8.7 2.4 1.2
 Sloping bottom	ACCESSIBLE STORAGE INACCESSIBLE STORAGE (Without sloping bottom) (With sloping bottom)	.0703	114 50 22	2.5 1.1 .5	171 75 33	3.8 1.6 .7	228 100 44	5.0 2.2 1.0	285 125 55	6.3 2.7 1.2	342 150 66	7.6 3.3 1.4	399 175 77	8.8 3.8 1.7
 Sloping bottom	ACCESSIBLE STORAGE INACCESSIBLE STORAGE (Without sloping bottom) (With sloping bottom)	.0633	144 70 20	2.5 1.5 .4	171 105 30	3.8 2.3 .6	228 140 40	5.0 3.1 .8	285 175 50	6.3 3.8 1.1	342 210 60	7.6 4.6 1.3	399 245 70	8.8 5.4 1.5

(2) Wide shallow bins are more efficient than deep narrow bins. For example:

Bin 8'-0" wide by 6'-0" provides 4.2 tons accessible storage and 0.3 ton inaccessible storage.

Bin 6'-0" wide by 8'-0" provides 3.7 tons accessible storage and 1.0 ton inaccessible storage.

(3) No additional accessible storage is gained by increasing the front-to-back dimension of the bin over 9'-0".

(4) The extra cost of construction of the sloping bottom is not justified unless the depth (front-to-back) of the bin is 8'-0" or greater.

Comparison of Capacities

For purposes of comparison, the capacities of a type B bin (with single shovel box) 12'-0" wide by 9'-0" were calculated. The results are compared with a type A bin of the same size in the table below.

Type of Bin	Width (ft.)	Depth Front to Back (ft.)	Accessible Storage (tons)	Inaccessible Storage (tons)	Accessible Storage (tons per sq. ft.)
A	12	9	7.6	3.3	.0703
B	12	9	4.58*	7.22*	.0424

This comparison shows that the type A bin is the more efficient type of bin when the fuel is to be handled by shovel.

---

*The total storage of the type B bin is greater than the total storage of the type A bin because the single shovel box in type B occupies less space.

4. Form of Bin for Bin-feed Stokers

The Stoker Manufacturers Association at present recommends that flat-bottom bins be used with bin-feed stokers. Sloping-bottom and hopper-bottom bins are objected to on the grounds that sloping bottoms tend to concentrate any moisture in the fuel in the vicinity of the stoker worm, thereby increasing the likelihood of corrosion of this part of the stoker. Another objection is that such bins are usually designed to be self-emptying; and as has been pointed out previously, it is possible for the home owner to neglect to check his fuel supply and suddenly find himself completely out of fuel.

The design of storage bins for bin-feed stokers is influenced by the type and size of conveyor arrangement placed in the bin proper. The majority of these stokers now manufactured use a simple uncovered worm conveyor buried in coal in the bin. The length of these screws depends upon the individual manufacturer's design and varies from 40 to 60 inches, with 48 inches being the most common size.

In all bins where the worm is buried in the coal, the fuel would have to be moved by hand in order to reach the worm and gear box (if any) if an obstruction occurred or a mechanical difficulty arose. The attitude of the manufacturers toward this problem seems to be that the problem occurs rarely and no special provision should be made for it. The bulletin entitled "Modern Anthracite Bins," published by the Anthracite Industries, Inc., gives the answer to this problem by providing for the removal of the worm without entering the bin. Special construction allows a slide to be inserted over the worm. This slide holds back the fuel during repairs.

The type of bin-feed stoker classified by the Stoker Manufacturers Association in their Technical Manual as "bunker type" is also arranged so that the worm and mechanism are more accessible. This type of stoker is not commonly manufactured--especially in small domestic sizes.

One company manufactures a special type of bin-feed stoker which makes use of a rotating collector arm (radius 18 to 24 inches). This arrangement will collect more coal in a given space than any other bin-feed stoker.

On the following page is a chart, entitled "Capacities of Flat-bottom Bins for Bin-feed Stokers." For purposes of capacity calculations, the following conditions were assumed:

(a) worm length, 48 inches
(b) angle of repose, coal on coal, 45 degrees
(c) coal stored level to 5 feet high
(d) 1 ton of bituminous coal occupies 45 cubic feet.

The arrangement of the bin is shown below.

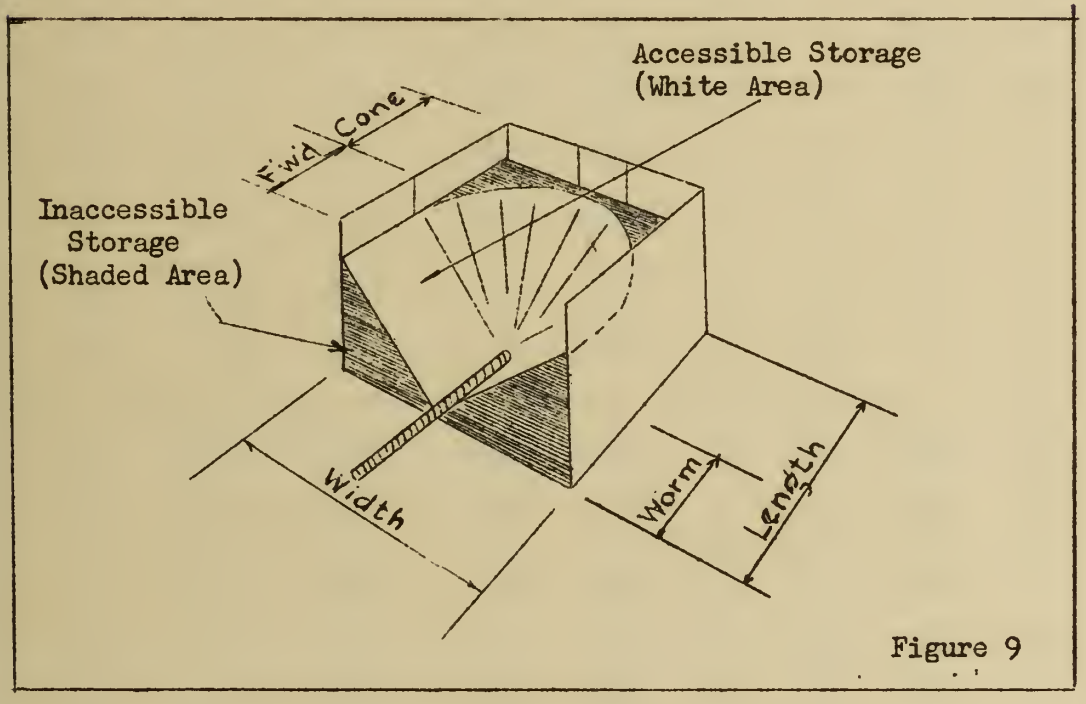


Figure 9

CAPACITIES OF FLAT-BOTTOM BINS FOR BIN-FEED STOKERS

DEPTH Front to Back—ft.		ACCESSIBLE STORAGE Forward cu.ft.	Cone cu.ft.	Total cu.ft.	Tons	Tons per sq.ft.	INACCESSIBLE STORAGE Forward cu.ft.	Cone cu.ft.	Total cu.ft.	Tons
9	Width 10 ft.	100	65.3	165.3	3.67	.0408	100	184.7	284.7	6.33
8		100	63.4	163.4	3.63	.0454	100	136.6	236.6	5.26
7		100	56.4	156.4	3.48	.0497	100	93.6	193.6	4.30
6		100	43.0	143.0	3.18	.0530	100	57.0	157.0	3.49
5		100	23.6	123.6	2.74	.0548	100	26.4	126.4	2.81
4		100	0.0	100.0	2.22	.0555	100	0.0	100.0	2.22
9	Width 9 ft.	99	64.9	163.9	3.64	.0449	81	160.1	241.1	5.36
8		99	63.0	162.0	3.60	.0500	81	117.0	198.1	4.43
7		99	56.0	155.0	3.44	.0546	81	79.0	160.0	3.56
6		99	42.6	141.6	3.14	.0582	81	47.4	128.4	2.85
5		99	23.3	122.3	2.72	.0604	81	21.7	102.7	2.28
4		99	0.0	99.0	2.20	.0612	81	0.0	81.0	1.80
9	Width 8 ft.	96	63.6	159.6	3.54	.0492	64	136.4	200.4	4.45
8		96	61.7	157.7	3.50	.0547	64	98.3	162.3	3.61
7		96	54.7	150.7	3.34	.0596	64	65.3	129.3	2.87
6		96	41.4	137.4	3.05	.0635	64	38.6	102.6	2.28
5		96	22.6	118.6	2.63	.0657	64	17.4	81.4	1.81
4		96	0.0	96.0	2.13	.0665	64	0.0	64.0	1.42
9	Width 7 ft.	91	60.8	151.8	3.37	.0535	49	114.2	163.2	3.63
8		91	58.9	149.9	3.33	.0594	49	81.1	130.1	2.90
7		91	52.0	141.0	3.13	.0638	49	53.0	102.0	2.27
6		91	39.2	130.2	2.90	.0690	49	30.8	79.8	1.77
5		91	21.4	112.4	2.50	.0714	49	13.6	62.6	1.39
4		91	0.0	91.0	2.02	.0722	49	0.0	49.0	1.09

From the chart on the previous page, the following conclusions can be drawn:

(1) The maximum amount of accessible storage (fuel which will flow to the worm), which can be arranged for the conditions stated above, is 165.3 cubic feet or 3.67 tons of bituminous coal. The dimensions of the bin are 10'-0" wide by 9'-0" deep (front to back). No increase in the amount of accessible storage can be accomplished by enlarging the dimensions of the bin.

(2) This form of bin is extremely inefficient as can be shown by comparison with a type A bin of the same size. Accessible storage in the bin-feed stoker bin is only 58% of that in the type A bin.

Type of Bin	Width (ft.)	Depth Front to Back (ft.)	Accessible Storage (tons)	Inaccessible Storage (tons)	Accessible Storage (tons per sq. ft.)
Type A (Flat Bottom)	10	9	6.3*	2.7*	.0703
Bin Feed (Flat Bottom)	10	9	3.67	6.33	.0408

(3) The back part of the bin (from the end of worm to the wall) is practically useless for providing accessible storage, as shown by the table below:

Section	Accessible Storage (tons)	Inaccessible Storage (tons)
First foot beyond end of worm	.525	.586
Second foot beyond end of worm	.432	.679
Third foot beyond end of worm	.298	.813
Fourth foot beyond end of worm	.155	.956
Fifth foot beyond end of worm	.042	1.069

It can be seen that a 9'-0" depth (front to back) of the bin can be reduced to 7'-0" without causing any significant decrease in the accessible storage. Such reduction increases the efficiency of the bin, as shown by the value for accessible storage in tons per square foot, which increases from .0408 to .0497.

(4) Similar increases in efficiency can be obtained by reduction of the width of the bin, but these increases are more costly in the loss of accessible storage space.

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*Total storage of the type A bin is less, due to the space occupied by the shovel boxes.

Type of Gun	Width (Ft.)	Depth Stowed in Deck (Ft.)	Armament Energy (Tons)	Incremental Energy (Tons)	Incremental Energy (Tons per Ft.)
Type C (Twin Turret)	20	7	5,400	6,000	.300
Twin Dual (Twin Turret)	20	7	5,400	6,000	.300

D. FACTORS IN BIN DESIGN--SIZE OF BIN

1. Seasonal Fuel Requirements

Before any size can be selected for a fuel bin, it is necessary to have some idea of the amount of fuel that will be needed annually. In some cases, the home owner may have a record or some idea of the annual consumption, and plans can be made on that basis.

When no records are available, or when a new house is being considered, a reasonably accurate estimate of fuel requirements for a normal heating season can be made by using this formula:

Heat supplied per year = Heat Loss per year

$$2000 \times V \times E \times F = \frac{DH\ 24}{t_i - t_o}$$

Where 2000 = Number of pounds per ton
V = Heating value in Btu. per pound of fuel
E = Overall house efficiency
F = Fuel required per year in tons
D = Number of degree days during normal year
H = Heat loss in Btu. per hour (as calculated for determining size of heating unit)
t_i = inside design temperature used in heat loss calculations
t_o = outside design temperature used in heat loss calculations
24 = hours per day

While this formula gives a satisfactory estimate for a normal heating season, it must be recognized that few heating seasons are "normal" and that the actual fuel requirements are likely to be greater or less than normal. Certain fuel merchants, in their recommendations for a bin to hold a season's supply, have recognized this variance by suggesting fuel bins should be "15 to 20 per cent larger than fuel requirements for a normal burning season"--"large enough to hold an abnormal cold winter's supply"--"one ton over a year's supply"--"large enough for 1½ times a year's supply." [1]

In an effort to discover the pattern of variation between normal to abnormal heating seasons, a study was made of detailed degree-day records for 54 cities of the United States during a nine-year period.[2] Records were compared to the normal number of degree days as determined over a longer period. Data was compiled only for seasons with a higher number of degree days than normal, and the overruns were expressed in percentages. As might be expected, the highest percentage variances occurred in those areas where fuel consumption is normally low. A winter which is 600 degree days colder over the whole United States is only 10% colder in a 6000 degree-day area, but is 20% colder in a 3000 degree-day area.

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1. Richmond, K.C., COAL HEAT, "How about Coal Bins, Their Size, Capacity and Accessibility," July, 1943, pp. 7-10.

2. Hotchkiss, C.H.B., and Stock, Clifford, Degree-Day Handbook, New York, Industrial Press, 1937.

A. Economic Flow Interpretation

[illegible] may also be obtained from (a) [illegible]. It is possible that this is the reason [illegible] that [illegible] be derived directly. In other words, the [illegible] may have a meaning of [illegible] demand [illegible], and [illegible] not [illegible] in that [illegible].

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Statistics for 9 years in 31 cities normally having winters rated at 5000 degree days or over, showed:

10 cities exceeded 10% over normal once each city
3 cities exceeded 15% over normal once each city
0 cities exceeded 20% over normal.

Statistics for 9 years in 16 cities normally having winters rated at 3000 to 4999 degree days, showed:

1 city exceeded 10% over normal three times
3 cities exceeded 10% over normal twice each
5 cities exceeded 10% over normal once each
7 cities exceeded 15% over normal once each
0 cities exceeded 20% over normal.

Statistics for 5 cities normally having winters rated at 2000 to 2999 degree days, showed:

2 cities exceeded 10% over normal 3 times each
3 cities exceeded 10% over normal 2 times each
1 city exceeded 15% over normal twice
3 cities exceeded 15% over normal once each
1 city exceeded 20% over normal twice
1 city exceeded 20% over normal once
0 cities exceeded 25% over normal.

From this data it seems obvious that a certain fuel storage safety factor must be provided in order to care for the colder-than-average seasons. A reasonable recommendation seems to be to provide for additional fuel, as follows:

In areas where the normal winter has:

5000 and over degree days, provide 15% extra fuel
3000 to 5000 degree days, provide 20% extra fuel
2000 to 3000 degree days, provide 25% extra fuel
In all cases, provide a minimum of $\frac{1}{2}$ ton extra fuel.

2. Normal Delivery Load

Another factor to be considered in selecting a bin size is the size of the normal delivery load. The bin should be large enough that a normal delivery load of fuel can be put in while there is still a carryover supply in the bin. The amount of the normal delivery load is controlled by the standard practice in the area in which the house is to be built. In a few certain areas, dealers make an extra charge if the coal is to be delivered in less than 4- or 5-ton loads. In most small communities, however, deliveries will be made over the driveway and trucks will carry smaller loads, probably about $2\frac{1}{2}$ tons to 3 tons.

3. Space Occupied by the Bin

Most small homes being built today contain a minimum amount of space and every square foot of area that can be utilized for living space must be so used. Basement space is not as valuable as first floor space, and usually any amount can be allotted for fuel storage. Space on the first floor is at a premium; any areas assigned for fuel storage and firing rooms must be quite small.

4. General Principles in the Selection of Bin Size

One popular recommendation is that the bin be large enough to hold "a season's supply." As has been pointed out before, a "season's supply" is a variable quantity and should include allowance for abnormally cold winters.

There are certain advantages gained by having a bin which will hold the season's supply: (1) The owner has the satisfaction of knowing his fuel worries are over for the season; (2) Any inconvenience caused by the delivery of fuel occurs only once during the season; (3) Maximum advantage can be taken of the savings afforded in those areas where fuel costs are lowered in the summer.

When the bin required is a relatively small one, there seems to be no disadvantage in storing a season's supply of fuel. However, when the bin becomes large, certain disadvantages inherent to larger bins are encountered: (1) Larger bins are less efficient; that is, the larger the bin, the more space occupied by dead storage; (2) Larger bins are more difficult to fill and may require hand trimming with the resulting inconvenience to the owner.

Size limitations are also influenced by the method of firing. If completely automatic firing is required, it is likely that the bin will have to be filled more than once each season, as the maximum accessible storage which can be provided for the usual type of bin-feed stoker is 3.65 tons of bituminous coal.

On the other hand, if the fuel is to be handled by shovel, a season's supply for a small house may be stored readily, as the type A bin is considerably more efficient than the type of bin used for bin-feed stokers.

Generally speaking, it is desirable to have a bin which will hold a season's supply of fuel, but in practice it is often found that smaller bins are more convenient in the long run as they occupy less space, have a proportionately larger storage of accessible fuel, and are more easily filled. Smaller bins may require two or three deliveries annually rather than one, but this should cause no inconvenience if the bin is properly designed and located. Whenever possible, however, the bin should hold at least a half season's supply of fuel.

5. Sample Bin Designs

Select a bin for a house equipped with hand-fired heater. The house has a calculated heat loss of 70,000 Btu. per hour and is located in a zone where the normal heating season is one of 5200 degree days. On the basis of an overall house efficiency of 70%, and a fuel rated at 12,000 Btu. per pound, the house would require 6.5 tons of fuel for a normal year. A 15% (.975 tons) allowance should be made for the overrun of an abnormally cold season. Therefore, the total fuel required per heating season would be about $7\frac{1}{2}$ tons.

Storage can be provided for this amount of fuel in two ways: (a) full season's storage, (b) half season's storage.

(a) For full season's storage, select a type A bin 12'-0" wide by 8'-0" with shovel-box openings on the 12-foot side. This bin has an accessible storage capacity of nearly $7\frac{1}{2}$ tons. With a sloping bottom (located as shown on the chart of type A bins) the bin has an inaccessible storage capacity of 1.0 tons which makes adequate provision for the emergency storage requirement of $\frac{1}{2}$ ton. Once this bin has been filled to the 5-foot level, the owner has a supply of fuel which will be sufficient for all but the most severe heating seasons. Furthermore, the full season's supply can be used without entering the bin to get it. The bin takes up considerable space, and it is of such a shape that two delivery chutes would be advantageous in filling it. If the bin were intended to be filled without inside trimming, the two delivery chutes should be specified. If no emergency storage is desired, the sloping bottom may be located accordingly.

(b) Assuming that the bin is to be designed for filling twice each heating season, the following design would be suitable. Provide a carryover factor (accessible storage to carry over between fillings of the bin) of $\frac{1}{2}$ ton. Then:

$7\frac{1}{2}$ tons (season's supply, including overrun)
$-\ \frac{1}{2}$ ton (carryover)

7 tons

Amount of each delivery:

$\frac{1}{2} \times 7$ tons = $3\frac{1}{2}$ tons
(carryover) = $\frac{1}{2}$ ton

For first delivery 4 tons

For second delivery $3\frac{1}{2}$ tons

Required accessible storage capacity of bin = 4 tons
Select bin 8'-0" wide by 7'-0" deep, no sloping bottom

Accessible storage	4.7
Inaccessible (emergency) storage	.8

If no emergency storage is desired, a bin 8'-0" wide by 6'-0" would be suitable.

ASH REMOVAL

A. OBJECTIVES

To attain the ultimate, it would be desirable to be able to burn solid fuel without producing any ashes. It is possible to prepare a solid fuel with a negligible ash content, but the expense of the preparation is prohibitive. It is safe to assume that there will always be an ash-removal problem in the burning of solid fuel.

The major objectives in the planning of homes to make ash removal a simpler task are:

1. Eliminate dust, dirt, and fumes resulting from ash and clinker removal.
2. Eliminate as much manual handling as possible.
3. Reduce the frequency of the ash-removal task.

As yet, there is no way in which ashes can be removed without involving some manual labor. However, in some cases it is possible to plan the home so that all the manual handling can be done outside of the house. It is also possible for the home owner to pay to have this manual labor done, but the expense may overrule the natural economy of solid fuels. Progressive fuel merchants can present one solution by offering the combined services of fuel delivery and ash removal.

B. THE PROCESS OF REMOVAL

The problem of getting rid of ashes may be broken down into three parts:

1. Removing ashes from the heating unit.
2. Removing ashes from the house.
3. Removing ashes from the premises.

1. Removing Ashes from the Heating Unit

The first problem is to get the ashes out of the heating unit. Most of the methods are manual.

(a) Ashes removed by shoveling from base of heating unit. This is probably the most common way in which ashes are handled in the majority of heating appliances. Dust is a great problem in this method. (See paragraph entitled "The Ash Dust Problem".)

(b) Ashes removed by shoveling from special floor pit constructed under the heating unit. (For pit design see Bulletin #MA-1 published by Anthracite Industries, Inc., entitled "Gravity Ash Removal Methods".)

(c) Ashes removed in removable container designed to fit in base of heating unit. A few appliances, usually the smaller ones, are designed with special ashcans which fit under the grates in the base of the heating unit. This device eliminates the necessity of handling ashes with a shovel.

[illegible]

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(d) Ashes removed in removable container from special floor pit constructed under the heater. (See "Gravity Ash Removal Methods".)

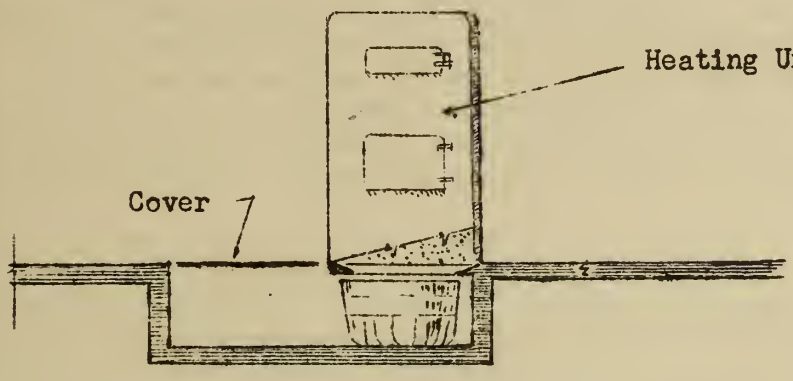


Figure 10
FLOOR PIT WITH
REMOVABLE ASH CONTAINER

(e) Clinkers removed by tongs through firing door of heater. A big problem with clinker removal is that fumes are given off by hot clinkers. Clinker stokers, when operated in mild weather, also produce some fine ash which must be removed by hand through the firing door or pulled over the hot fire in order to form the ash into clinkers. (See paragraph entitled "The Problem of Clinker Fumes".)

(f) Ashes removed mechanically by ash-removal stoker. Ashes are collected and transferred to a covered ash can by the ash-removal type of stoker. At present, this type of stoker is commonly used only with low volatile coals. However, certain companies are advertising ash-removal stokers for use with higher volatile coals.

Discussion

Of the above methods, the mechanical method (f), is the best as there is no labor involved in taking the ashes out of the heating unit, and dust is eliminated since the ashes are placed in a covered container. This method, however, is expensive, as it involves the purchase of an ash-removal stoker and, furthermore, such stokers are at present not universally adapted to all solid fuels. If the owner can afford to use an ash-removal stoker, it is an extremely desirable piece of equipment.

Ashes in the form of clinkers are usually easily handled, but some arrangement must be made so that the clinkers can cool off before being handled in the heater room. If not, clinker fumes make their removal a very undesirable job. Furthermore, clinker fumes should not be allowed to circulate through the house. Of course, handling ashes in the form

of clinkers is basically undesirable as it is a hand method. The clinkers must be removed by tongs and then carried out of the house. Ashes in the form of clinkers do have the advantage in that there is little dust involved in the handling.

Whenever possible, the shoveling of ashes should be eliminated. It is the chore of shoveling ashes and the dust and dirt involved which creates much of the dissatisfaction with solid fuels. One exception should be made to this statement--that is the case where ashes fall from the heating unit into a pit which can be emptied from the outside of the house. This would likely be a long-time storage pit and the ashes would probably be removed by hired help rather than by the owner himself.

Methods (c) and (d), in which ashes fall from grate to container, are preferable to the method of shoveling ashes. However, few heating appliances are designed with an ash container as part of the unit. Appliance manufacturers should give this desirable feature more consideration in the plans for future designs. When such appliances are not available, it is possible to effect the removal in the same manner by building a special ash pit under the heating unit and allowing the ashes to drop from the grate into a container placed in this ash pit. The construction of the ash pit, of course, is an additional expense. It will need careful design in those areas where ground water makes drainage a problem. From the standpoint of economy, it would be more satisfactory to have the pit and container furnished as part of the heating unit rather than to have to build the pit on the job.

The Ash Dust Problem

Whenever ashes are handled, a certain amount of dust will be raised--the amount will depend upon how carefully the job is done.

Ashes should always be removed from the ash pit before the grate is shaken. If the grate is shaken first, the dust will not settle before it is necessary to open the ash door. Furthermore, the dust from hot ashes spreads very badly due to the air currents set up by the temperature difference. When ashes are shoveled out of the base of the heater, or out of an ash pit beneath the heater, and then shoveled into an ash can, dust may arise. This dust can spread through the house, especially if the firing room is not isolated from the rest of the house.

One common method of reducing dust in the handling of ashes is to dampen them. This is a satisfactory method but it has the disadvantage that it makes the ashes heavier and therefore more difficult to handle. Studies have been made on the optimum amount of water to be used to hold down the dust without increasing the weight of the ashes too much. Rough measurement made on one batch of ashes indicate that when enough water is added to keep down the dust, the weight of dry powdery ashes is increased 12.5% (from 38.1 to 42.8 pounds per cubic foot). A 5-gallon can filled to the usual height (not quite full, so that ashes will not fall out) with dampened ashes, weighed 26½ pounds.

Dampening ashes can be done in several ways. If the ashes are in the pit of the furnace, a hose can be used to spray water on the ashes or water can be poured into the pit with a bucket. Care must be taken that the water does not strike the grate. The best procedure is to dampen the ashes at night and then remove them in the morning before shaking the grate. The same method can be used when the ashes are in a pit under the burner. When a long-time ash-storage pit is used, and the access for removal from this pit is from the outside, the ashes can be sprayed with water just prior to and during their removal. It is also possible to completely flood the ashes in the pit and then allow the excess water to dry off before removing the ashes from the pit. Another method is to provide a slow drip of water adjusted to provide the correct amount of moisture in the pit, but this requires careful adjustment. Another device which has been used is a specially constructed ash-pit spray either with or without an automatic control for the quantity of water. In some cases, people make a practice of shoveling ashes out of the heater into an ash bucket partially filled with water. This is not as effective as dampening the ashes in the pit before they are touched, as there is still the probability that some dust will be stirred up in the shoveling process.

When ashes drop directly from the grates into a removable ash can, it is possible to prevent scattering of dust by merely dampening the top layer of ashes in the ash can. Since it is not usually possible to do this dampening while the container is still under the grates, care must be taken to prevent dust rising while the ash can is pulled out of the base. Another solution is to provide a tight cover for the ash can. It is desirable to place the cover on the container before it is moved, if this is possible. If not, the cover should be put on the ash can as soon as it is out of the pit or heater.

When ashes are taken from the firing room, they should be dampened or covered to prevent scattering of dust in the house. In order that they can be handled without spilling, ash cans should not be filled to the brim.

Although the elimination of ash dust in the house is important, it is not the only problem. Any ash dust blown about adds to the dirt in the air, and such dirt is a nuisance where outdoor living is common. Furthermore, ash dust can ruin the washing hanging on the line of the home owner or his neighbor. Covering the ash cans will prevent dust from blowing while the ashes are standing outside, but when the cans are emptied into the ash-removal truck, clouds of dust will arise unless the truck is specially designed to prevent this. Dampening the ashes offers more all-around protection against dust, but, as mentioned before, the ashes are heavier and it is more of a job to handle them. Another disadvantage--containers of dampened ashes cannot be allowed to stand outside for long in cold weather as the ashes will freeze in the can and then cannot be taken away.

The Problem of Clinker Fumes

Hot clinkers removed from the firebed in the clinker-type stoker give off extremely unpleasant and noxious gases. Provisions must be made so that these fumes do not penetrate to the living rooms of the house.

One of the simplest and most consistently satisfactory methods of eliminating the nuisance of clinker fumes is to place the hot clinkers on the shelf of the fire door before removing them from the burner. In this way the gases may escape up the chimney while the clinkers are cooling. The clinkers can be removed as the first operation when the fire is again cleaned.

Certain stoker companies manufacture clinker cabinets which are attached in front of the furnace or boiler below the fire door. Clinkers are extracted from the fire bed and dropped in the clinker cabinet for cooling. Fumes from the cooling clinkers are exhausted through a vent to the fire chamber of the furnace.

Another solution is to provide a vented space (with a flue to the chimney) as part of the chimney structure. Hot clinkers may be dropped in their containers and then placed in this space and fumes will be exhausted through the chimney. It is also possible, of course, to set the container holding the clinkers out-of-doors for a cooling period. In both of these last two methods, fumes will escape into the firing room during the period the clinkers are handled.

2. Removing Ashes From the Firing Room to Outdoors

These methods are manual:

(a) Carried-- up an outside basement stair.
up an inside basement stair and out a service entrance at grade. (See "Ash Removal and the Basement Stair".)

(b) Setout-- ashes set out through a basement window onto grade or into areaway. (See the "Ash-Setout Areaway".)

(c) Simple Pulley Hoist-- ashes set out into a deep areaway and hauled to grade by simple block and tackle. The bottom of the areaway is at the level of the basement floor or slightly above it.

(d) Dumbwaiter-- ash can placed on dumbwaiter and raised to grade. This dumbwaiter is usually shown located in the garage.

One method requiring no handling of ashes in the house is:

(e) Ash Pit with Access from Outside

The ash pit is constructed so that ashes drop directly into the pit from the grate. The ashes in the pit are removed from the outside. In some instances the pit may be small, and designed to hold a container into which the ashes fall. The container is removed frequently. (See "Gravity Ash Removal Methods".) In another scheme the pit may be large and the ashes are removed less frequently. In this case they might be removed by shoveling, or by mechanical equipment brought in for the purpose.

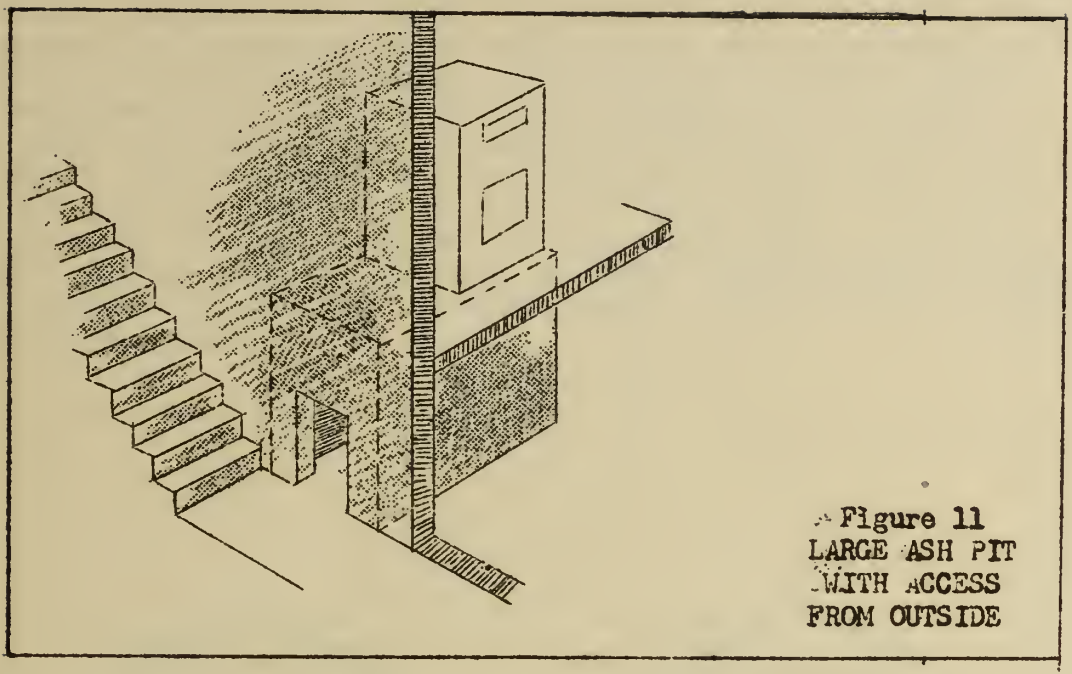


Figure 11
LARGE ASH PIT
WITH ACCESS
FROM OUTSIDE

Ash Removal and the Basement Stair

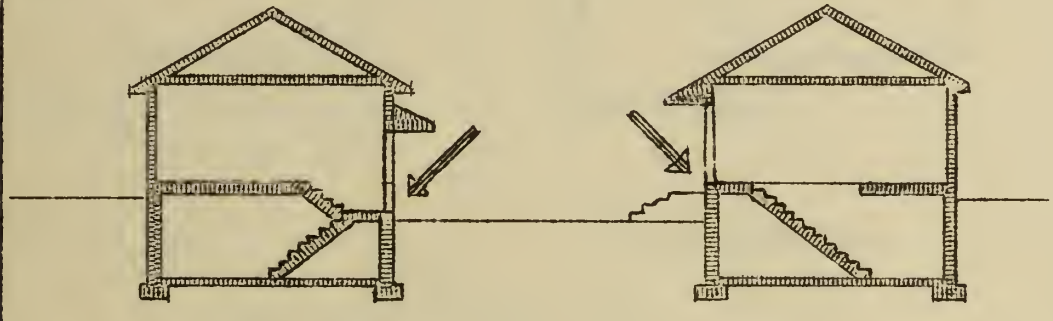
The basement of the home has many uses. The heating plant and fuel storage will be located in the basement; the home laundry and winter clothes drying space may be located there. The basement is also an excellent storage area. Food, both fresh and canned, trunks, extra furniture, window and door screens, storm doors and windows, garden tools, seasonal household items--any of these items may be stored in the basement. Also, quite frequently, a portion of the basement is used as a recreation area and for a hobby shop.

Traffic to and from these basement activities must pass over the basement stair (or stairs). There are two lanes, or routes, of traffic which the stair must serve:

1. Outdoor--Traffic from out-of-doors to basement.
2. Indoor--Traffic from living or working areas of the house to the basement.

Outdoor traffic includes heating plant service, laundry room access, access to storage space for garden products, garden tools, screens, storm windows and doors. Indoor traffic includes owner's access to the heating plant, laundry room, hobby shop, recreation room, and access to storage for food, trunks, and furniture.

The primary consideration in planning the access to the basement should be to provide for the servicing needs of the home--primarily the servicing of the heating plant. It is especially important that careful consideration be given to planning basement access when the ashes are to be carried out of the basement. For ash removal, and for most traffic from outdoors, it is desirable to have a direct connection between the basement and the service yard at grade level. A single inside stair which extends from basement to first floor without a grade entrance is not satisfactory. Such a stair makes it necessary for the owner of the house to carry laundry or ashes up the full flight from the basement to the first floor, out-of-doors, and then down three or four steps to grade. The added work of going up and down three or four extra steps while carrying ashes or laundry is not necessary.



GOOD
Entrance at Grade Level

POOR
Entrance at First Floor Level

Figure 12

Furthermore, when an inside stair from the basement to the first floor without a grade entrance is used, the plan is usually such that the ashes must be carried through a passage open to the living or working areas of the house, or through a portion of the working area itself. Such an arrangement is an invitation to the scattering of dust throughout the house.

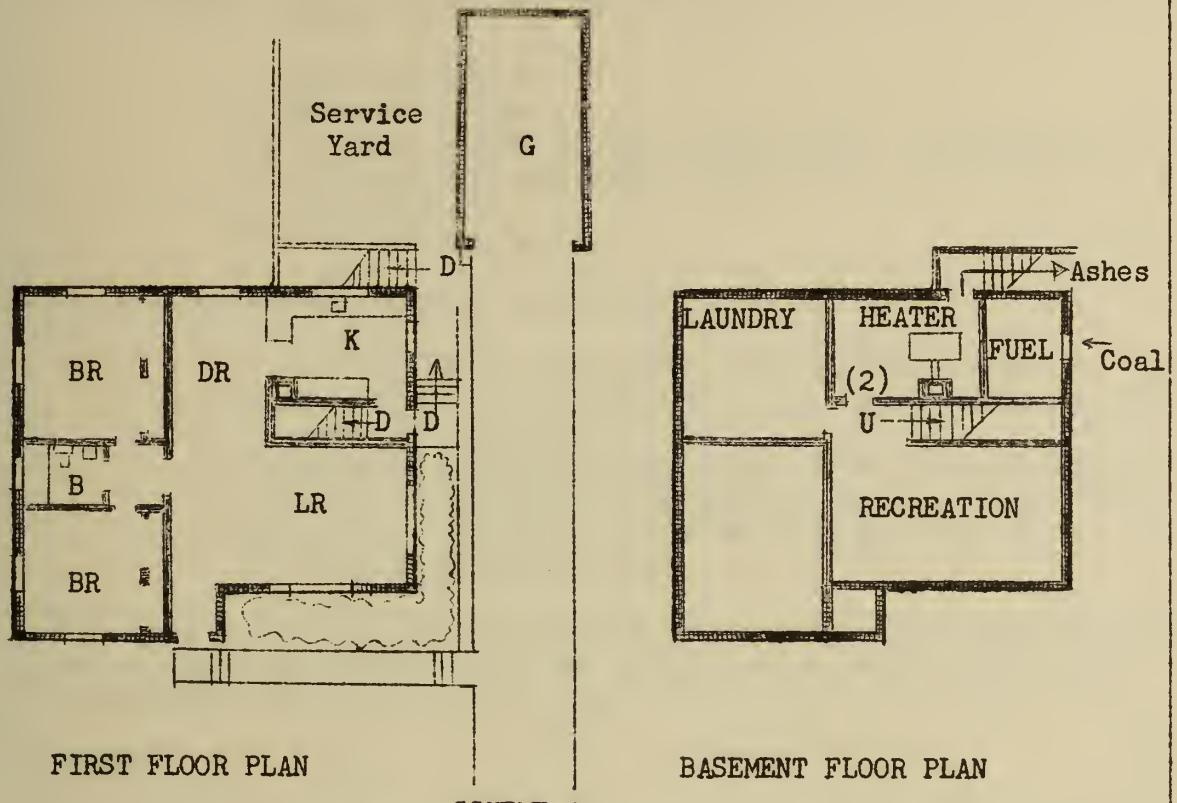
When ashes are to be <u>carried</u> from the basement heater room to the outside, either of two access schemes must be provided:

Scheme A -- two stairs--<u>inside stair plus outside stair</u>.

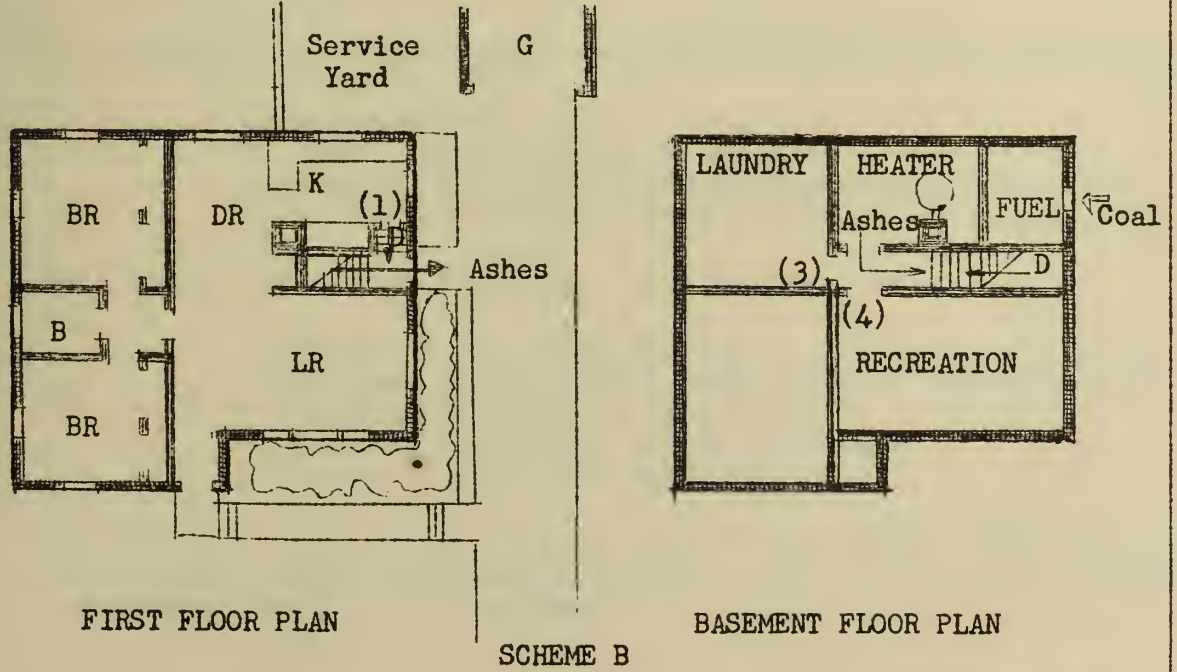
Scheme B -- one stair--<u>inside stair with an outside entrance to the stair at grade level</u>.

Description and Function of Basement Stair Schemes

Below are two homes which are identical except for the scheme used for basement access:



SCHEME A
(With Outside Basement Stair)



SCHEME B

Figure 13

Scheme A

Outside basement stair from heater room to driveway or service yard. Full flight inside basement stair from working area of first floor to basement.

The outside basement stair will be used for:

1. Handling ashes
2. Fuel bin access
3. Carrying washed clothes from laundry to drying yard
4. Handling screens, storm windows, etc., to be stored in the basement
5. Handling the garden tools.

The inside basement stair will be used for:

1. Owners' access from first floor to heater room
2. Carrying soiled laundry to laundry room (unless clothes chute is provided)
3. Handling household items to be stored in the basement
4. Access to recreation and hobby rooms
5. As an alternate route for handling washed clothes from basement to drying yard.

Note that by locking door #2 (between heater room and basement hall) the heater room, the fuel bin, and the outside stair can be completely isolated from the rest of the house.

Scheme B

Single inside stair with landing and entrance at grade line. Grade entrance on driveway or service yard. In this scheme the same stair is used for all purposes. The top of stair is in the kitchen or working area of the house.

The basement stair from basement to grade entrance will be used for:

1. Handling ashes
2. Fuel-delivery service, if required
3. Carrying wet clothes from laundry room to drying yard
4. Access to storage for garden tools, screens, etc.

Full stair from kitchen to basement will be used for:

1. Owners' access to heater room
2. Carrying soiled laundry from the house to laundry room (unless clothes chute is provided)
3. Handling items to be stored in basement
4. Access to recreation and hobby rooms.

Note that to isolate the heater and fuel-storage rooms from the remainder of the house, three doors must be locked: Door #1 on the first floor, and doors #3 and #4 in the basement.

Comparison of Scheme A and Scheme B

Studies of the two schemes show that the two-stair layout has the advantage of allowing the complete separation of outdoor and indoor traffic to the basement. Outdoor traffic is inclined to be the dirtier and rougher of the two, and it is advantageous to keep this traffic away from the stair which will be used for general basement access.

In the two-stair scheme, when door #2 is locked in the basement, the heater and fuel-storage rooms are isolated. This is especially advantageous when the owner expects to make a contract with an ash-removal service to remove ashes from the heater room. It is possible to leave the outside basement heater-room entrance unlocked for this service and yet have the remainder of the basement isolated and secure.

Provision of the outside basement stair allows the architect or designer of the house more flexibility in planning, as the inside stair need not be located to take care of heating plant servicing problems. Actually, the inside stair may be placed without regard to the outdoor service area, although it is usually the best practice to locate the basement stair in connection with the service area of the house.

Of course, the construction of two stairs is an added expense, and the outside basement stair, if open, sometimes is hazardous if small children are likely to be playing near it. Also, the open basement stair is difficult to keep free of snow, ice, and leaves. Drainage must be provided at the bottom of the stair. Although the outside stair is especially desirable for servicing the heating plant, consideration of the fact that fuel deliveries will occur only once or twice a year, and ash removal from the basement will only occur on the average of once a week during the heating season, may mean that the lack of separation of indoor and outdoor basement traffic in Scheme B does not seem to be a serious disadvantage.

The single stair with outside grade entrance saves the cost of one outside door (between the outside stair and the heater room) and of the outside concrete stair and wall. With the inside stair, there is no drainage or snow and ice removal problem.

In small homes where initial cost is a large factor, Scheme B should be entirely satisfactory, although it is acknowledged that when the additional investment can be made, the second outside service stair is desirable.

The Ash-Setout Areaway

Using the basement stair to carry out ashes or clinkers is probably the most common method, but it is still inconvenient. Even with a well-planned basement, a proper stair, and a grade entrance, it is a back-breaking job to carry a bushel basket of ashes out of the basement. (Five-gallon size containers are better as they are smaller and usually have bails so that they can be handled more easily. Two 5-gallon cans may be carried at one time.) It is possible that in

some cases the home owner would prefer to use an arrangement such as the "ash-setout areaway."

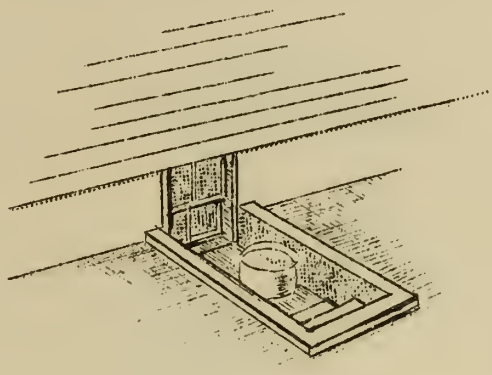


Figure 14
ASH-SETOUT AREAWAY
VIEW FROM OUTSIDE

In the ash-setout areaway removal scheme, containers of ashes are set out through a basement window into an areaway. The design is such that the home owner steps up one or two steps on a movable platform in the basement, raises the container of ashes about 30 inches above the top of the platform (about desk height) and slides them over the window sill out on to the skids in the areaway. It is recommended that the ash container be about 5-gallon can size and in any case not larger than bushel basket size. The ash-setout areaway offers the advantage that the normal week's accumulation of ashes or clinkers (perhaps about two bushels or four 5-gallon cans) can be placed outside from the basement in practically one operation. If the ashes are carried up, a trip would have to be made for each bushel, or each pair of 5-gallon cans.

If the ashes are removed by a private contract service, the ashman can remove the ashes directly from the areaway. If ash disposal is a city government service, the owner will probably be expected to take the ashes out of the areaway and place them at the street curb or in the alley. He will probably use a child's wagon or something of the sort to help in this task.

The areaway works best when placed on the side of the house where at least 24 inches of foundation wall is exposed. When the areaway is so placed, only 3 steps down from grade are necessary to reach the level where the ashes have been placed from the basement. (See sketch.)

It is possible, of course, to use the ash-setout areaway where there is less foundation wall exposed. In this case, however, more steps are required from grade to the level of the areaway.

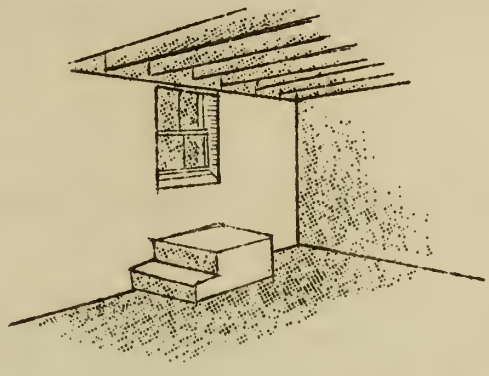


Figure 15
ASH-SETOUT AREAWAY
VIEW FROM INSIDE

The ash-setout areaway has the distinct advantage of allowing more flexibility in planning the house. When an areaway is used, it is not necessary that the basement stair be placed primarily with the idea of removing ashes directly from the basement. In fact, if it so desired, the basement stair may be placed independently of the heating plant design, although it must be remembered that the basement stair will still be used in most cases for access to the coal bin for hand trimming during the delivery of coal.

3. Removing Ashes from the Premises

The third step is the final removal of the ashes from the lot. The responsibility for the final disposition of the ashes may be with

(a) an agency of the city government
(b) the home owner himself.

Some cities are organized to pick up the ashes from the service area of the house and lot. Other cities will pick up ashes only at the street curb or alley, and it is the owner's responsibility to see that the ash cans are at the designated place on collection days.

In those cities that provide no ash collection service, the home owner contracts with some private rubbish and ash hauling agency to remove the ashes. This sort of service will usually pick up the ashes somewhere near the house so that it is not necessary for the owners to handle the ashes once they are out of the basement. In some cases the service will

include removing the ashes from the basement. (Access for this purpose, ideally, should be arranged so that the service man may reach the firing room without passing through other portions of the basement or house.)

Where homes have been designed with ash storage pits large enough to hold a season's or half season's accumulation, a special service is required. This service should remove the ashes from the storage pit and haul them away.

C. SUMMARY

Cost economy is the controlling factor in the design of satisfactory ash-removal facilities.

Probably the user of solid fuel is most satisfied when his heating plant is arranged so that the ashes fall directly from the grates into a large storage pit which requires emptying only once or twice a year. This pit is constructed so that the ashes can be removed from the outside. The cost of this arrangement is likely to be prohibitive when the heating plant is in the basement, as it requires construction of a large pit below basement level plus construction of outside access to the pit. When the heating plant is on the first floor, the long-time storage pit is more feasible as the construction involved is less expensive.

Another good arrangement is the ash-removal stoker combined with a properly designed basement stairway or ash-setout areaway for removing the ashes from the house. Adaptation of this type of stoker to the use of all solid fuels is desirable. Cost, in the form of first cost of the stoker unit, is definitely a limiting factor in using the ash-removal stoker for small homes.

With present costs, the average small home owner will probably have to be satisfied with some arrangement for gravity ash removal. A heating unit designed with an ash container to fit under the grates in the ash pit would be best, but since these are not commonly available, a pit may be built under the heater as a substitute.

HEATER ROOM

A. GENERAL

The firing room is the heart of the heating system of the home, and must be well located and well arranged in order to perform all its functions properly. All of the following activities or functions must be provided for:

Into the room must come--
- The fireman (by the basement stair)
- The fuel (by shovel or worm conveyor from the bin)
- The air for combustion (by infiltration, window, or duct from outside)
- The returning cooled heating medium (return ducts and pipes).

Out of the room must go--
- The fireman
- The ashes (by stair, ash-setout areaway, ash hoist, or other device)
- The gases of combustion (by the chimney)
- The warmed heating medium (by supply ducts and pipes).

Proper space and the most convenient arrangement possible must be provided for all of the above functions and all safety regulations must be obeyed.

B. HEATER ROOM LOCATION

The location of the heater room is influenced by a great many factors; most of these factors are so interdependent that it is actually impossible to consider one without the other. However, for purposes of clarity, the items will be separated and listed below and then discussed in order.

1. Location of the fuel bin
2. Location of the heating unit
3. Location of the chimney
4. General basement access
5. Location of the facilities for ash removal.

1. Location of the Fuel Bin

The fuel bin is probably the first portion of the heating plant located in the basement, although it is usually placed with some thought of the heating unit location in mind. The location of the bin is normally determined in relation to the driveway and will probably be against the basement wall at one side of the house--often times in a corner. The heater room will be placed adjacent to one of the inside walls of the fuel bin.

2. Location of the Heating Unit

The location of the heater room is also dependent upon the position of the heating unit. The location of the heating unit itself is quite a task, and there are many problems which must be considered.

(a) Distribution System

Probably the most important single factor involved in the location of the heating unit is the type of heating distribution system that is to be used.

(1) Gravity Warm-Air Heating Systems

The furnace of this system should be located centrally in the basement for best results. The heating medium is air and the circulation is due entirely to gravity. Properly designed warm-air gravity systems normally have individual round leader pipes 8" to 14" in diameter leading from the top of the furnace to each room. These pipes leave the furnace radially and slope upward to the registers in the rooms. Best operation will be obtained when these pipes are as short as possible, and reasonably near the same length; hence, the requirement for central or near central location in the basement. When deviation from this rule is necessary, the furnace should be located closer to those rooms of the house which will be most difficult to heat in unfavorable weather. Consideration should be given to location of the furnace with respect to the return air ducts which are larger than the leader pipes but fewer in number. Considerable space is required for duct work; headroom is often limited in certain areas.

(2) Forced Warm-Air Systems

Heating units for these systems may be located with considerably more leeway than gravity warm-air systems as the circulation of the warm air is maintained by a fan or blower. This makes it possible to use combined supply ducts, rectangular in shape, and place them flat against the ceiling of the basement. The forced circulation due to the fan makes it possible to run these ducts longer distances, thereby permitting location of the furnace away from the center of the house. Return air ducts are more numerous but less in the way than in the gravity system. Less space is required for ductwork than in the gravity systems; ceiling height is seldom impaired. Furnace location depends more upon compact duct layout and convenient space planning in the basement than upon requirements for heating performance.

(3) Hot Water Radiator and Steam Radiator Systems

In hot water radiator and steam radiator systems, the heating medium is hot water or steam which is circulated in small diameter pipes or tubing. Supply and return pipes to the rooms rise vertically from basement main (or mains) which usually run around the basement near the outside walls at the ceiling. Boiler location depends more on economical main layout and convenient basement planning than upon requirements for heating system performance.

(b) Noise

There is always a certain amount of noice attendant to the operation of a coal-burning central heating plant, whether hand or stoker fired. For this reason it is advisable to give some consideration to locating the heating unit beneath a working part of the house, that is, the laundry, utility room, kitchen, or bathroom. If this is not possible, it is preferable to place the unit under the living room rather than under a bedroom.

(c) Warmth Over the Central Heating Unit

The heat loss from the central heating unit can be advantageously regained by locating the unit under a room where excess heat will be of no disadvantage. Locating the unit under the bathroom is exceptionally desirable as it is almost impossible to make a bathroom too warm. Most persons prefer a cool bedroom for sleeping; therefore, it is not advisable to place the furnace or boiler under a bedroom.

It is also necessary to locate the heating unit with respect to the proper relation to the fuel bin, ash removal facilities, basement access, and chimney. These factors will be discussed in connection with their general relationship to the heater room.

3. Location of the Chimney

The heater room should be located so that it includes the chimney within its walls. The location of the chimney must be planned in connection with the general room layout of the house as well as in connection with the heating plant. Factors to be considered as desirable are as follows:

(a) Locate the chimney so that it will be near the heating unit and serve this unit properly. The F. H. A. regulations require that the length of the smoke pipe between the heating unit and the chimney should not exceed 8 feet.

(b) Locate the chimney near the center of the house. From the point of view of heating economy, the chimney should be located inside the house. When the chimney is located in this way, a considerable amount of heat may be regained from that ordinarily lost in the flue gases. This is especially true in the case of a two-story residence.

(c) If a fireplace is desired in the home, the chimney should be located so that one chimney will serve both the heating plant and the fireplace. This arrangement is the most economical possible.

4. General Basement Access

The heater room should be located in relation to the provisions for general basement access. The room should be as near to the basement stair as is possible and yet the stair should be arranged so that it may serve both for heater room access and general basement access. It is desirable to have the arrangement such that it is possible to close off the rest of the basement from the path between the heater room and the outside entrance. This will help maintain cleanliness and security in the basement and the house, when it is necessary to provide access to the heater room for the coal deliveryman.

If the basement stair is to be used for ash removal, special considerations must be made.

5. Facilities for Ash Removal

The relationship between the heater room and the ash-removal facilities should be as listed below. It is desirable to have access from the heater room to the outside as directly as possible. One of the following arrangements should be available:

(a) Special outside ash-removal stairway should connect directly with the heater room and lead to the driveway and service area.

(b) If the general basement stairway is to be used for ash removal, the lower end of the stair should be immediately outside of the heater room and should lead to a grade entrance on the driveway or to the service area.

(c) Ash-setout areaway should be located just outside the heater room with direct access thereto.

(d) Ash can hoist should be located just outside the heater room with direct access thereto.

(e) When long-time ash-storage pits in the floor are used, the ultimate object is to place the pit so that ashes may be removed from the pit from outside the house.

C. ARRANGEMENT OF THE HEATING ROOM

1. General

Where possible, it is desirable to isolate the heating section (fuel storage, heater, and ash storage) from the other useable areas of the basement. This is desirable to eliminate further any possibility of dust and dirt from the handling of fuel and ashes being scattered through the house. It is also desirable in order that the rest of the basement can be secured from the heating plant so that outside help may have access to this portion of the basement without disturbing the rest of the house. For best space utilization, this will usually mean using one end or corner of the basement for the heating plant and leaving the rest of the basement free for other uses such as laundry, recreation, hobby shop, and storage.

2. Placement of Heating Unit

(a) Clearances for Fire Safety

The chart below shows required clearances around coal-fired heating units as specified by the Federal Housing Administration and the National Board of Fire Underwriters.

AUTHORITY	TYPE OF HEATING UNIT	CLEARANCES (in inches)				
		Front	Side	Side	Rear	Above
F.H.A.*	Warm-Air Furnace Jackets (Temperature 200-400° F.)	18	18	12	12	12
F.H.A.*	Plenums of Warm-Air Systems exposed to direct rays from coal-fired heating surface					8
F.U.**	Mechanical Warm-Air System (250° F. limit control)	48	6-1	6-1	6-1	3-1
F.U.**	Other Warm-Air Systems	48	18-6	18-6	18-6	18-4
F.U.**	Hot Water or Steam Systems (not over 15# ga. pressure)	48	6-1	6-1	6-1	6-2

Notes:

* F.H.A. Appendix E of "Minimum Property Requirements for Properties of One or Two Living Units", (State of Indiana), published by the National Housing Agency, Federal Housing Administration, September, 1946.

Reduction of required clearances is permitted when special protection is applied to surfaces.

** F.U. Section 1201 of "Building Code", recommended by the National Board of Fire Underwriters, New York, 1943 edition.

When two figures are shown, the requirement varies within the limits shown. Maximum clearance is required unless special types of protection are provided as specified in the Code.

(b) Layout and Clearances for Firing

(1) Bin-feed Stokers

The most common type of bin-feed stoker is the "straight-line relay"* stoker. The typical layout for this type is shown below.

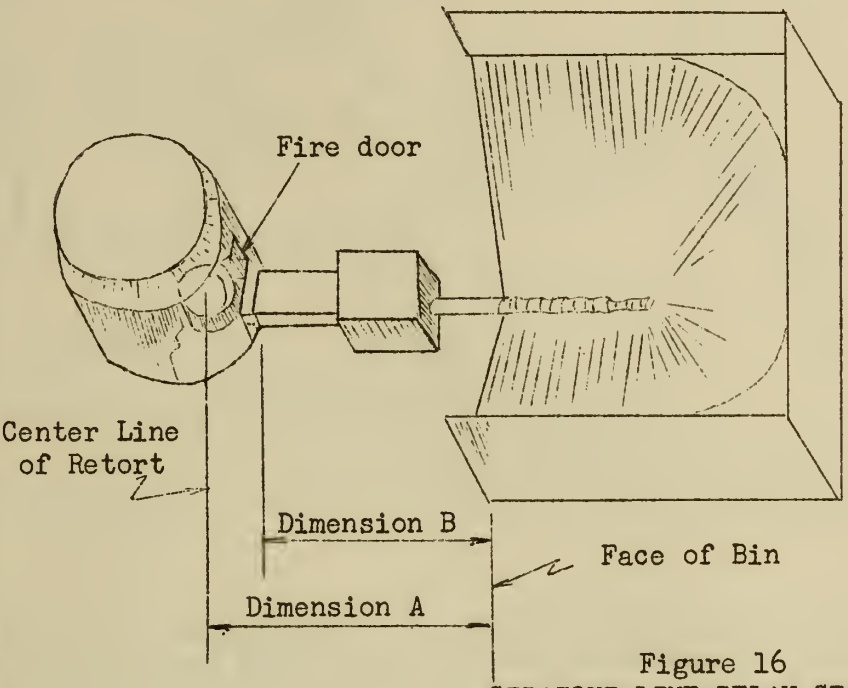


Figure 16
STRAIGHT-LINE RELAY STOKER

Dimension A, from bin face to center line of retort, varies with the manufacturer. A common value seems to be about 6'-0". Dimension B, of course, is less, and depends also upon the size of the heating unit. It is approximately 4'-6". This type of stoker is designed for use in a standard furnace or boiler. Normally the retort is inserted through the ash door. As a result, the fire door is directly over the stoker windbox, and the mechanism is in the way when clinkers are to be removed. By cutting the furnace or boiler, it is possible to insert the stoker unit from the side rather than from the front, but this is an expensive job and should be done only by a skilled mechanic.

At least two companies have combined this same "straight-line relay" type of stoker with a specially adapted heater, and jacketed the two as one unit. Added convenience is gained by placing the firing door on the opposite end of the unit, thus eliminating the interference of the mechanism. The layout recommended by one company is shown on the next page.

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* Terminology from "Technical Manual", Stoker Manufacturers Association, Chicago, Illinois, 1944.

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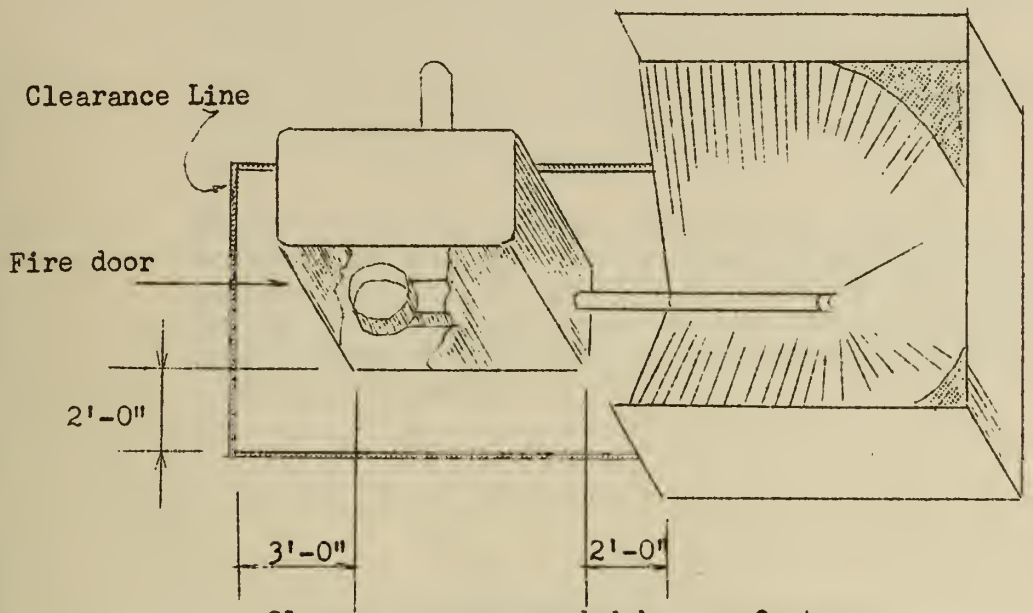


Clearances recommended by manufacturer

Figure 17
COMBINED STOKER-HEATER UNIT

The dimensions shown are recommended by the manufacturer in these words: "A clearance of 2 feet around both sides and rear and at least 3 feet clearance at the front of the unit is required as a servicing and adjusting space." The dimension of 3'-0" seems inadequate to provide for handling of clinker tongs. A minimum of 4'-0" is recommended, with 5'-0" preferred.

Dimension C shows the space required to accommodate one brand of this combined stoker-heater.

Provision of a special universal joint converts the above type of stoker into an "adjustable angle relay" stoker. This allows the heater to be placed at an angle to the face of the bin wall.

The "reverse drive straight-line" stoker has the disadvantage that a gear box is located in the fuel bin. Planning principles are similar to the "straight-line relay" stoker.

Two other types of stokers are produced. Only small quantities are manufactured in residential sizes. The "pull through straight-line" type has the worm conveyor on one side of the furnace, and the motor and drive mechanism on the other. The "bunker direct drive" stoker has the motor and mechanism located under the sloping sides of a hopper-shaped fuel bin.

(2) Hand-Fired Heating Units

The most important requirement in placing a hand-fired heating unit is to provide for handling a shovel. It is possible to turn around inside a 4-foot diameter circle while holding a shovel, but this is the minimum. To swing around, as on a pivot, with a shovel takes about a 7-or 8-foot diameter circle.

The most convenient scheme that can be arranged for hand firing is shown below. The fireman need only make a quarter turn from the fuel bin to reach the firing door. The nearest shovel box should not be located too close to the heater in order that it will not be awkward to turn from the box and fire the unit.

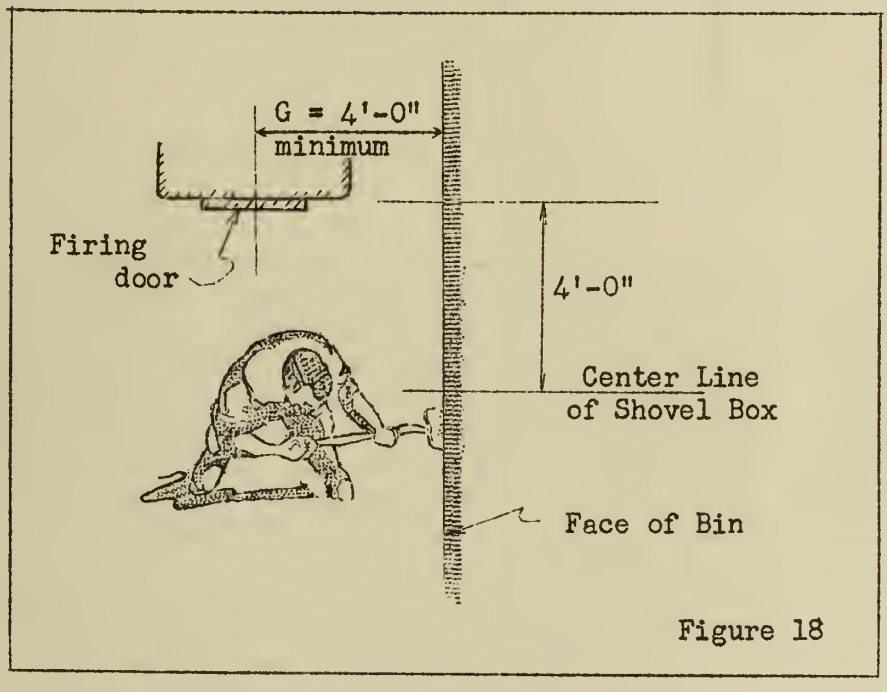


Figure 18

This is an excellent arrangement for bins with one or two shovel boxes. However, if the bin is quite wide, and has several shovel boxes, the distance between the most remote shovel box and the heater becomes large enough to be inconvenient. Furthermore, the total space required in the basement is great.

Later installation of a hopper-style stoker would be difficult in this arrangement. The hopper itself would probably block access to most of the fuel shovel boxes unless dimension G has been increased to provide proper clearance.

Another scheme, which is shown below, requires a half turn from the bin to the firing door.

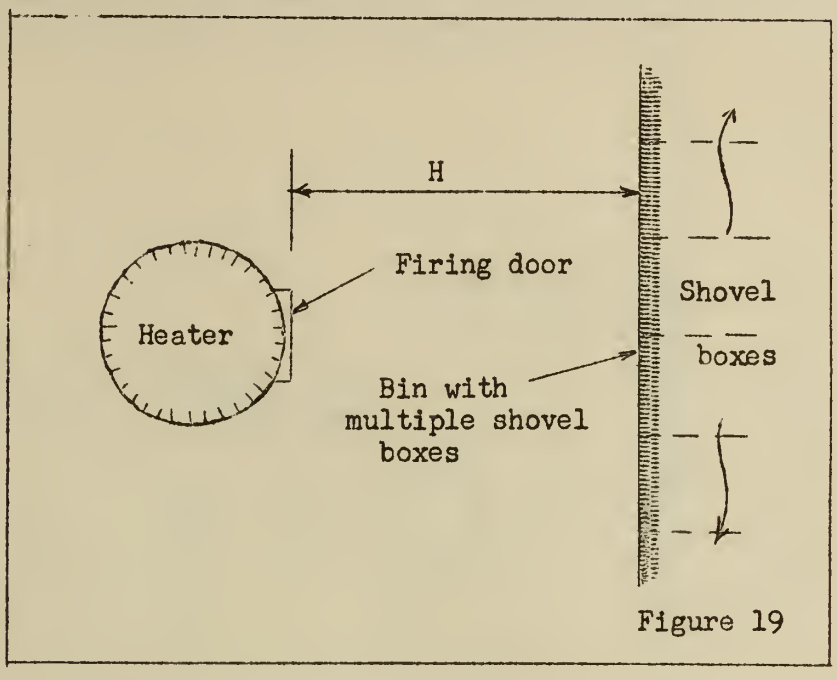


Figure 19

With the heater placed more centrally, the distance between the various shovel boxes and the firing door becomes more nearly equal. This is probably a more suitable scheme for bins with shovel boxes across the entire front. Distance H should be an absolute minimum of 4'-0", and 5'-0" or 6'-0" would be preferred. If a hopper stoker is to be installed at a later date, dimension H must be considerably enlarged. (See paragraph on hopper stokers.) To provide proper clearances between the shovel boxes and the hopper of the future stoker, the distance between the bin and the fire door will probably have to be around 9'-0". This distance is greater than is generally considered desirable for handling fuel with a shovel, but should be provided if the hopper stoker is to be installed at a later date. However, if the heater is placed 5'-0" or 6'-0" from the bin for hand firing, a bin-feed stoker can be readily installed at a later date.

(3) Hopper Stokers

At present the most popular type of stoker is the hopper stoker. The predominance of this type is undoubtedly due to the fact that it is quite suitable for converting hand-fired equipment. In installing this type, the usual method is to insert the retort and wind box through the ash pit door opening to save cutting the furnace. This scheme means that the hopper is in front of the fire door and in this position makes clinker removal awkward. In some stokers, the wind box is lengthened so that more clearance is provided. The stoker can be connected at the side of the heating unit by cutting the casing and ash pit walls.

The layout for this type of stoker closely follows the recommendation for hand firing, as the critical factor is the provision of room for handling a shovel.

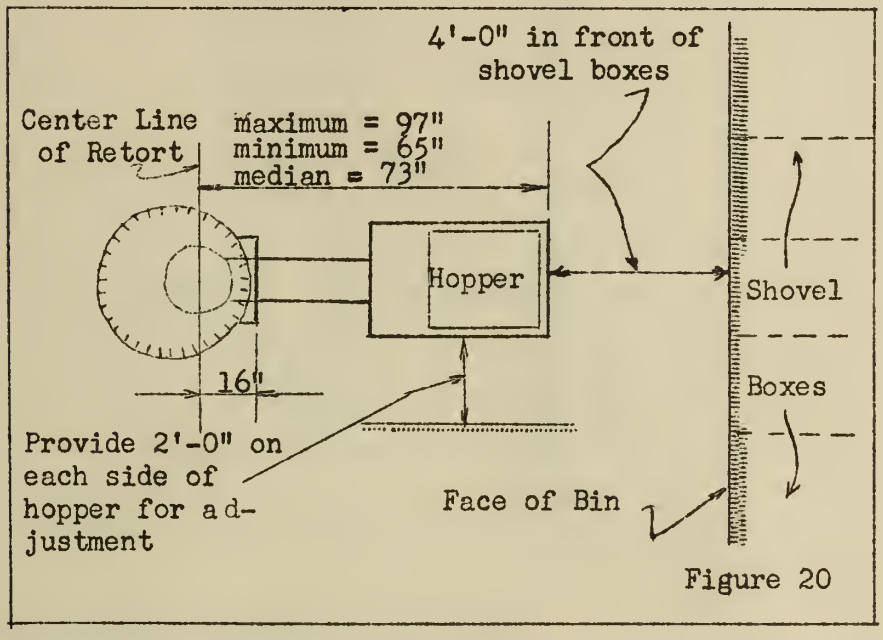


Figure 20

At least 4'-0" must be provided in front of the shovel boxes which are to be used. Allow 2'-0" as clearance around the hopper for servicing. Dimensions shown in the illustration give an idea of the variances in stoker sizes, and show the need for a thorough knowledge of the dimensions of the unit to be installed. Firing by hopper stoker requires a larger distance between the heater and the face of the bin than any other firing method. This fact should be considered in placing a hand-fired furnace, if it is thought probable that a hopper stoker will be added later.

If it is possible to load the hopper from the side, a better scheme might be used in which the side of the hopper is parallel to the wall of the fuel bin, as shown below.

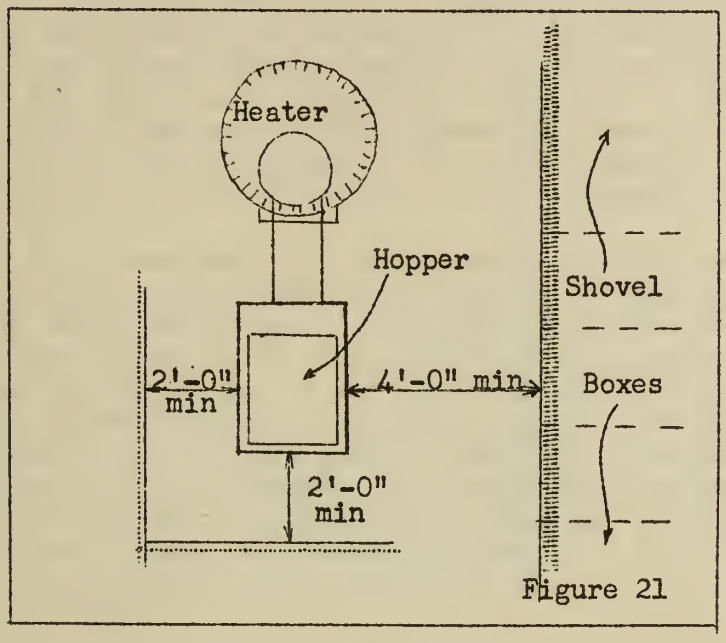


Figure 21

3. Arrangement for Ducts, Pipes, and So Forth

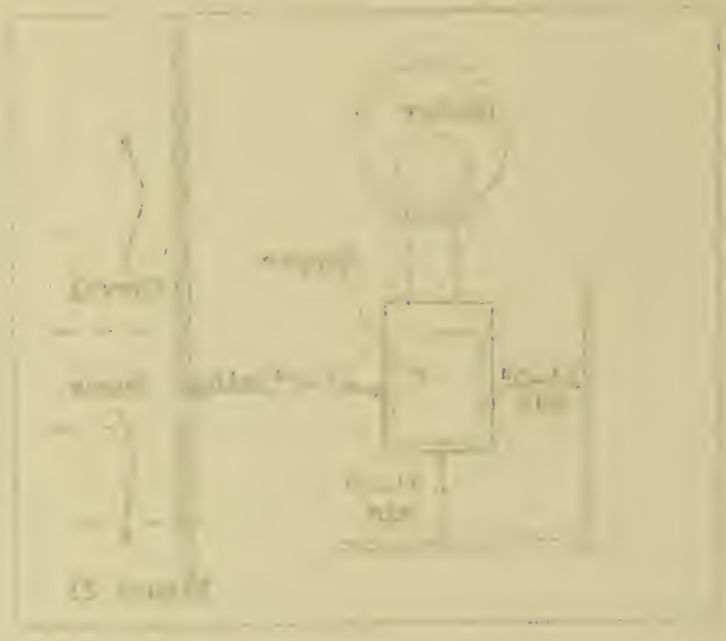
The location of the heating unit must be considered in relation to the ducts or pipes which it supplies.

Pipes from hot water or steam boilers are usually small and do not create much of a problem.

Ducts for mechanical warm-air systems must be planned in connection with the space available in the heater room and the position of the heater. There are various arrangements for the connection of these ducts to the furnace unit, and as a result the type of furnace to be used must be studied carefully in connection with the layout of the heater room.

Gravity warm-air systems require more duct space than any other type. Careful consideration must be given to duct layout in order that the efficiency of the heating system will not be impaired. For example, if a single return air duct is to be used, it is desirable that this duct enter the rear of the furnace casing directly opposite the firing door. If two returns are used, they may enter on opposite sides.

No specific rules can be laid down for the proper arrangement of the firing room to accommodate duct layouts. Each home is an individual problem.



HOUSE AND PLOT PLANS FOR SOLID FUEL USE

A. GENERAL

Most owners and designers will have certain definite preferences as to the arrangement of their house on the lot, location of garage, etc. They will also have a preference in the internal arrangement of the living space of the house as it is affected by the orientation of the house and the type of lot. Some owners will prefer the living room to face away from the street and to open into and form a living unit with the private garden in the rear, while others will want the living room to be on the street side of the house. This arrangement will be affected by the orientation of the lot as well as by personal preference.

The owner will also have certain preferences as to the location of the service entrance and service area of the house. He may desire this part of the house to be to the front, to one side, or to the rear. He will also have some preference as to the location of his garage--it may be attached or unattached--it may be set back from the front of the house, parallel to it, or set forward of the house. Good planning requires that the location of the service area on the plot should not conflict with the area to be used for living and recreation. In many cases the planning is such that the kitchen and work areas are on the street side of the house in order that the living areas may take full advantage of the back yard as a private outdoor living area.

Things that must be considered in the plot plan layout, of course, are the character and landscaping of the surrounding houses, and the building codes of the particular area. In some regions of the United States it is quite common to find the garage or service area placed forward of the house on the street side of the lot, while in other areas this sort of planning would be out of place. Furthermore, certain city building codes prohibit the placing of the garage forward on the street side.

No matter what disposition the final plot plan shows, it will affect the arrangement for delivery of solid fuel. Most new homes are likely to be built in areas where there are no alleys, and access to the garage will be from the front street. Furthermore, all servicing of the house (fuel and food delivery, ash, garbage, and rubbish removal) will be done from the street by means of the driveway to the garage. In other words, the garage driveway serves a second purpose as the service artery to the house. The planning of the house and lot must be done so that this servicing is easy and yet provision must be made for garbage, rubbish, ash cans, and so forth, so that they do not become an eyesore. Also, it is well to give some thought to the location of a clothes drying area and its relationship to the service entry of the house.

Another major factor affecting the arrangement of fuel delivery, ash removal, and heating facilities, is economy. In the small house the additional expense of a second chimney for a fireplace cannot be justified. One chimney with two flues is cheaper than two chimneys with one flue each. If the small house is to have a fireplace, it should be planned so that one chimney will be located to serve both the fireplace and the heating unit.

This requirement is often difficult to meet when proper arrangement of other elements is considered.

When the small house is to have a full basement, and ashes are to be carried out of the basement, the basement stair should be located so that it will serve as a convenient route for ash removal as well as for general access to the basement. To do this, the stair should lead from near the heater room to a grade entrance opening on the driveway or near it. Normally, this grade entrance should serve as the one service entry to the house and be conveniently located to the kitchen and garage.

An alternate scheme for the ash removal is the ash-setout areaway. Use of this areaway allows more flexibility in planning the basement stair. In larger homes where the economic factor is not so pressing, ash removal may be accomplished by some other means than the inside basement stair--an additional outside basement stair or an ash hoist of some fashion may be used.

Additional expenditure is sometimes required in order to provide a satisfactory arrangement for solid fuel use. Oftentimes extra money must be spent in order to achieve the best results. Typical cases are those where the best results are obtained by building the fuel-storage bin under the garage, driveway, or service area. Other times advantages are gained by providing additional driveway space. The individual designer must make the final decision as to whether or not the additional expense involved in these designs is justifiable.

B. HOUSE AND PLOT PLANS--HOUSES WITH BASEMENTS

Following are some plans showing typical examples of the variety of relationships which can be arranged between driveway, garage, coal bin, and service entrance to accomplish coal delivery, ash removal, and general servicing of the house with the greatest convenience. These houses may be built with complete or partial basements. Space requirements, personal desires, economic factors, and type of heating plant will influence the choice for complete or partial excavation. In all of the examples shown, the only portion of the basement which must be constructed is that shown to be occupied by the storage bin, heater room, and stairway access thereto. The additional basement space may be used for storage, recreation, laundry, or work space, as desired.

This group of houses has been designed on the basis of the following assumptions:

(1) The houses will have full or partial basements. Heater room and fuel storage will be in the basement or at the basement level.

(2) Fuel will be delivered directly from truck-to-bin by

(a) conveyor or motor trimmer to a coal chute in the foundation wall, or

(b) direct dumping or conveyor to a manhole in top of coal bin.

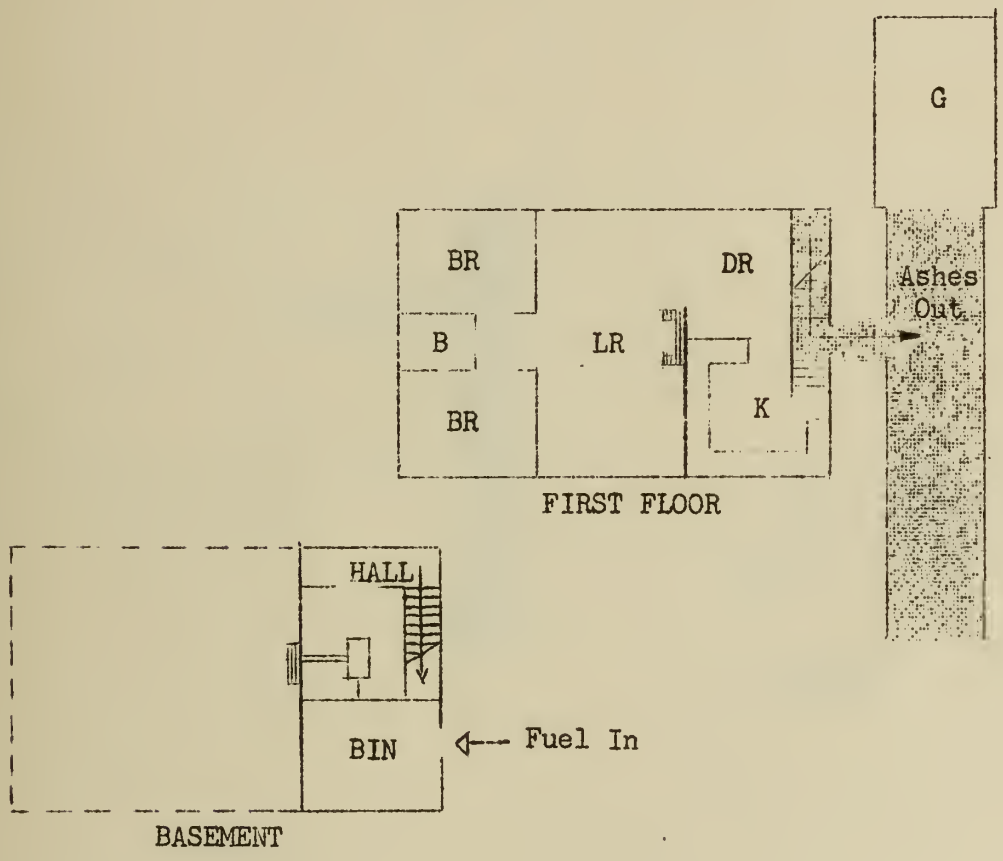
(3) Where foundation-wall chutes are used, they will be located on the driveway, and the finish grade of this driveway will be 38" or 40" below first floor level, and 20" below the grade at the front of the house.

(4) Ashes will be removed from heater room by carrying them up the inside basement stair and out an entrance at grade level to the driveway.

1. Detached Garage — Set to Rear of House

Certain advantages can be gained by building the garage separate from the house— foundations need not be so deep, danger of fire in the house is lessened, the architectural problem of designing a suitable roof for the garage is eliminated.

House #1

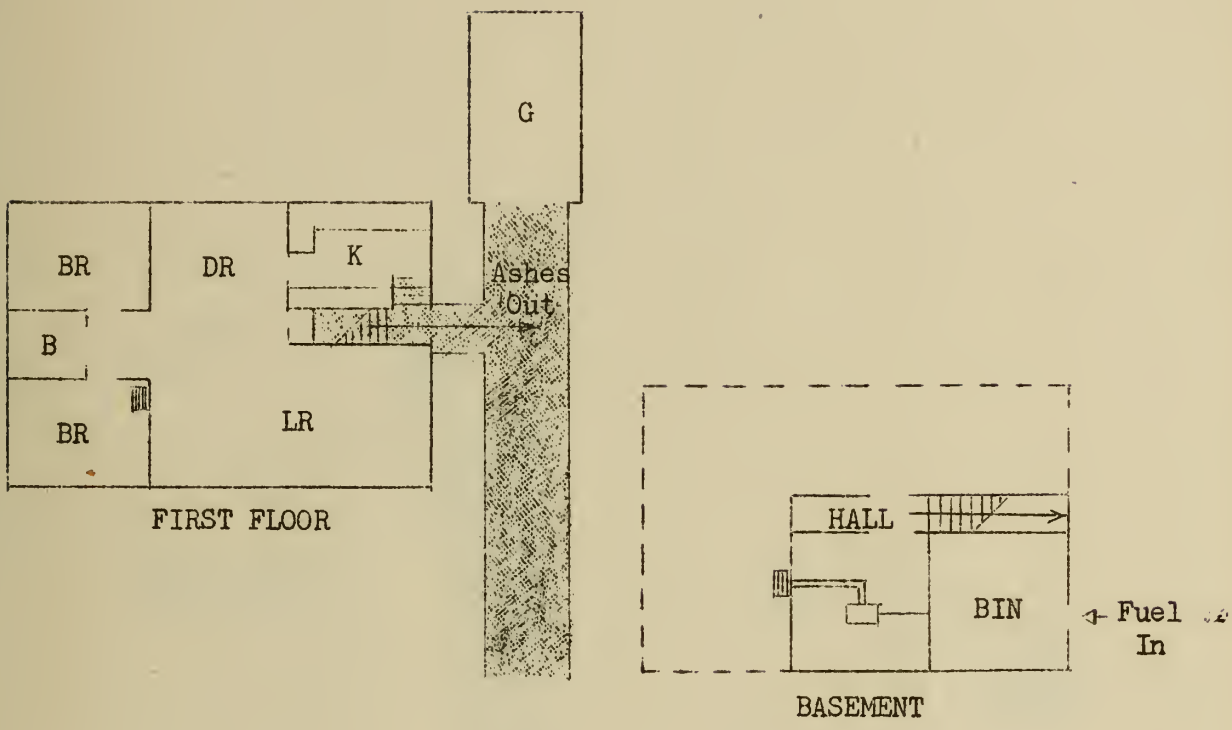


Comments

Garage detached.

Heating unit not centrally located, therefore not suitable for gravity warm-air system. The wall forming the hall may be eliminated if the other portion of basement is not used. Service entry serves driveway, kitchen, and all parts of basement. Stairway blocks light on one side of house.

House #2



Comments

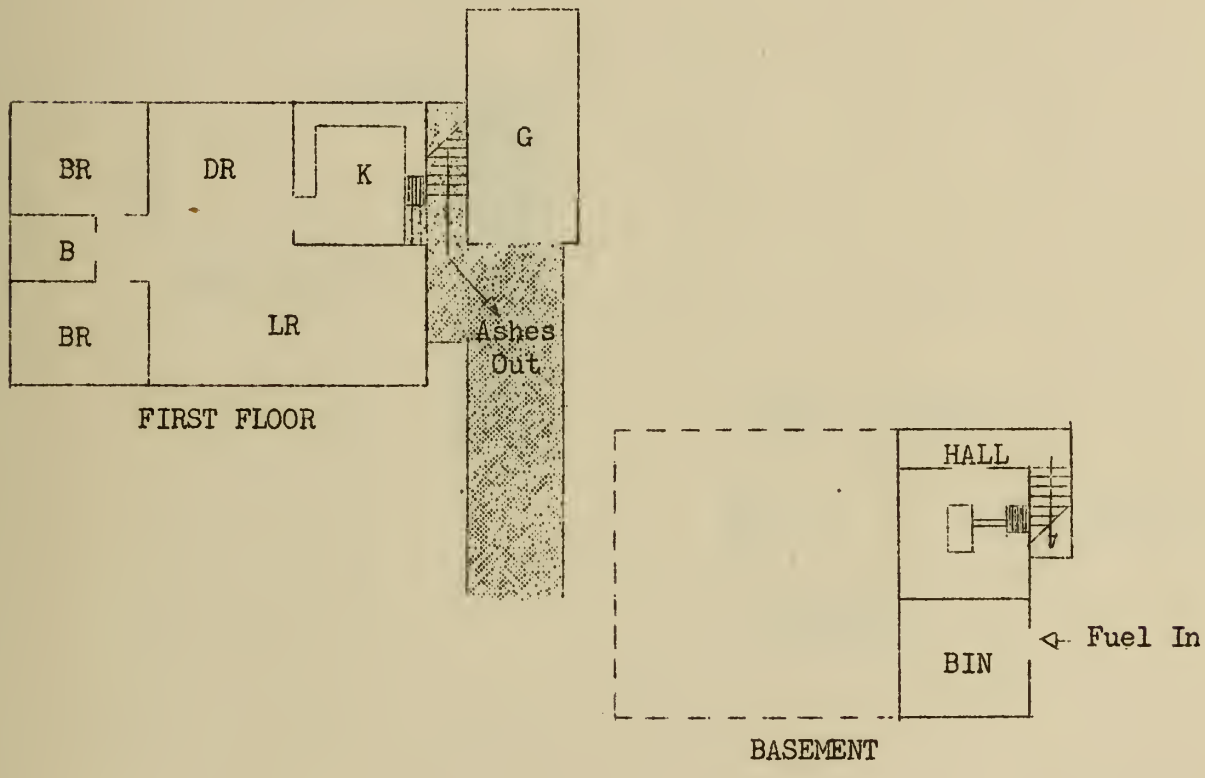
Garage detached.

Service entry serves driveway, kitchen, and all parts of basement.
Stairway on interior.

2. Garage Attached at Side— Set Back from Front of House

In many houses built today the garages are attached to one side of the house, but set back slightly from the front. With this particular scheme,it is easy to deliver solid fuel to a bin in the basement of the house from the driveway at the side. This delivery is best accomplished by means of a conveyor.

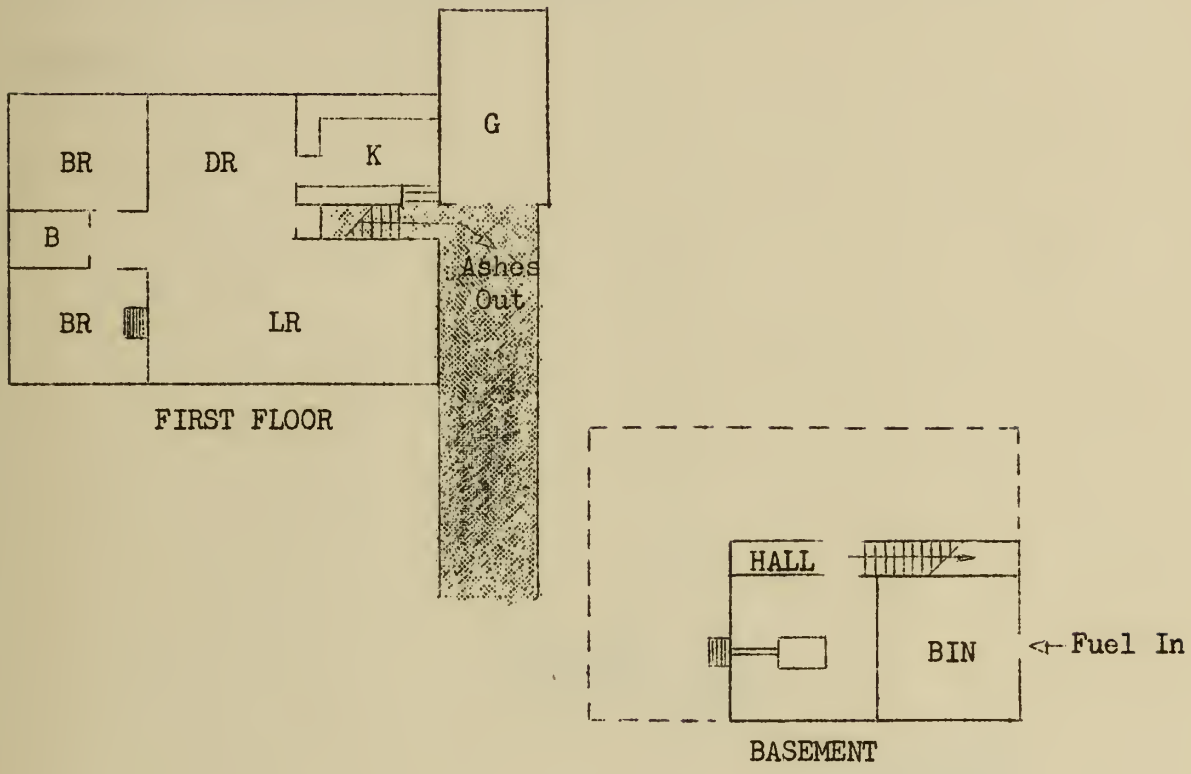
House #3 (Similar to House #1)



Comments

Garage attached, otherwise same as for House #1.

House #4 (Similar to House #2)



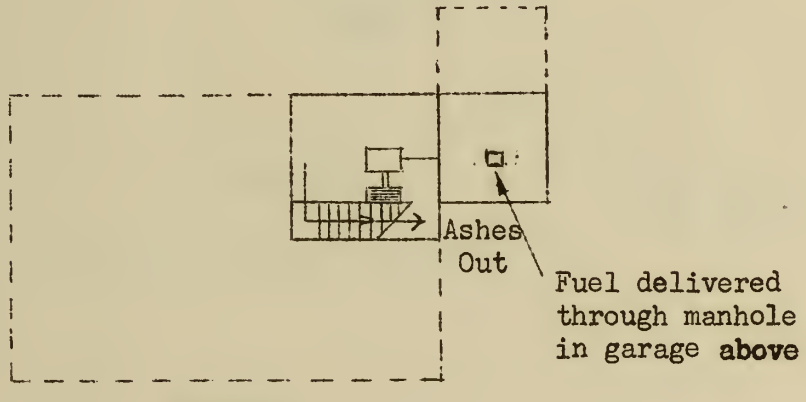
Comments

Garage attached, otherwise the same as for House #2.

When the additional expenditure can be justified, a more convenient arrangement can sometimes be gained by excavating an additional area not under the main portion of the house. The added expenditure is for the extra excavation, foundation, walls, and covering slab as required.

A solution which often proves convenient is placing the fuel bin under part of the garage. This, of course, involves the additional expense of deeper foundation walls for part of the garage plus the reinforcement of the portion of the garage floor slab which will carry the weight of the car.

House #5



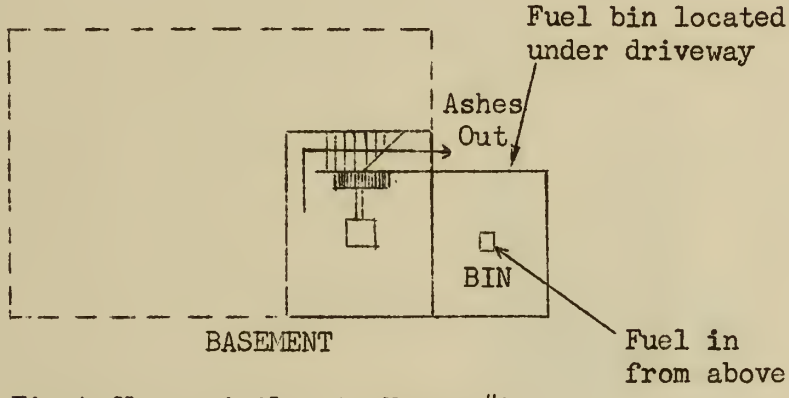
First floor similar to House #4

Comments

Garage set back. Coal delivered from truck-to-bin by conveyor — truck does not enter garage. Service entry serves garage, kitchen, and all parts of basement. Slab over bin must be reinforced to carry automobiles.

Another solution, but more expensive, is the use of a bin under the drive. This is probably the easiest type of delivery for the fuel merchant as he can dump directly into the bin without conveyor, but it is a more expensive installation because the slab over the bin must be capable of carrying the weight of the truck. Also additional foundation work is required.

House #6



First floor similar to House #4

Comments

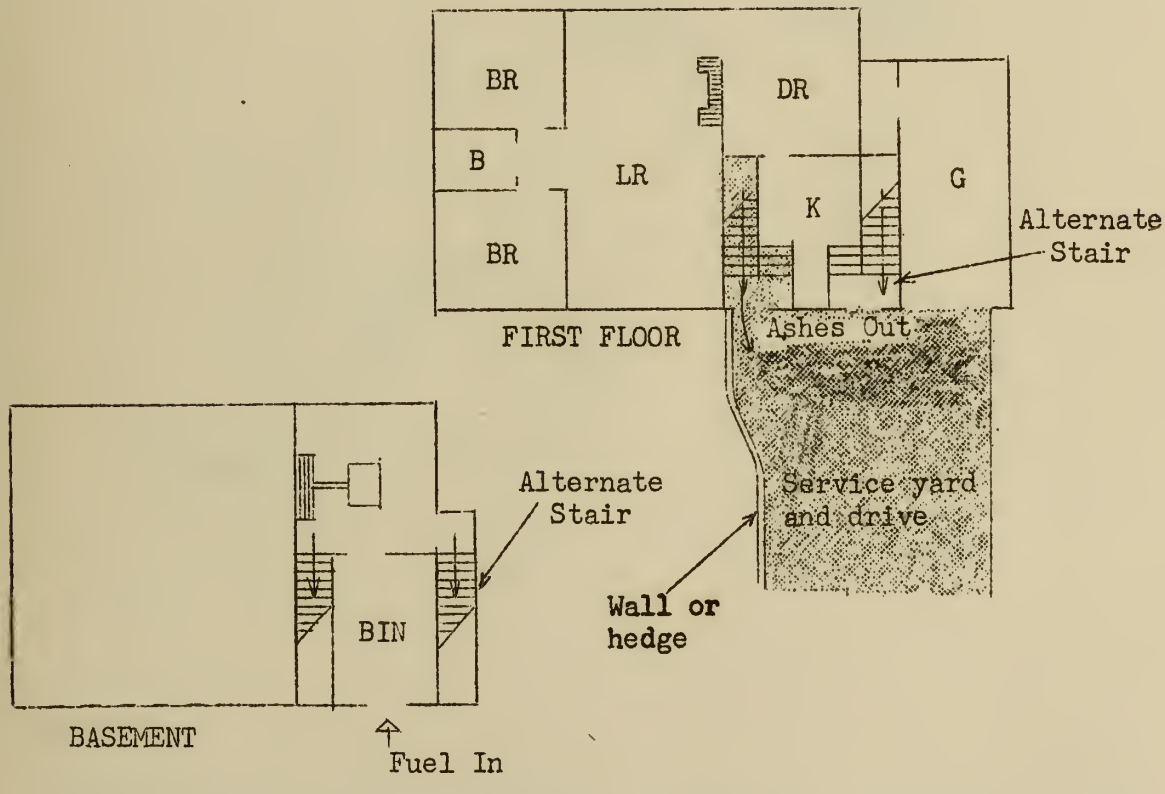
Garage set back— coal dumped from truck-to-bin. Service entry serves garage, kitchen, and all parts of the basement. Slab over bin must be reinforced to carry loaded trucks.

3. Garage Attached at Side— Front of House and Garage Parallel

When the garage is on the side of the house, and is not set back from the front, the coal cannot be delivered easily. It is difficult to make provision for solid fuel delivery in this type of house, and additional expenditure must be made.

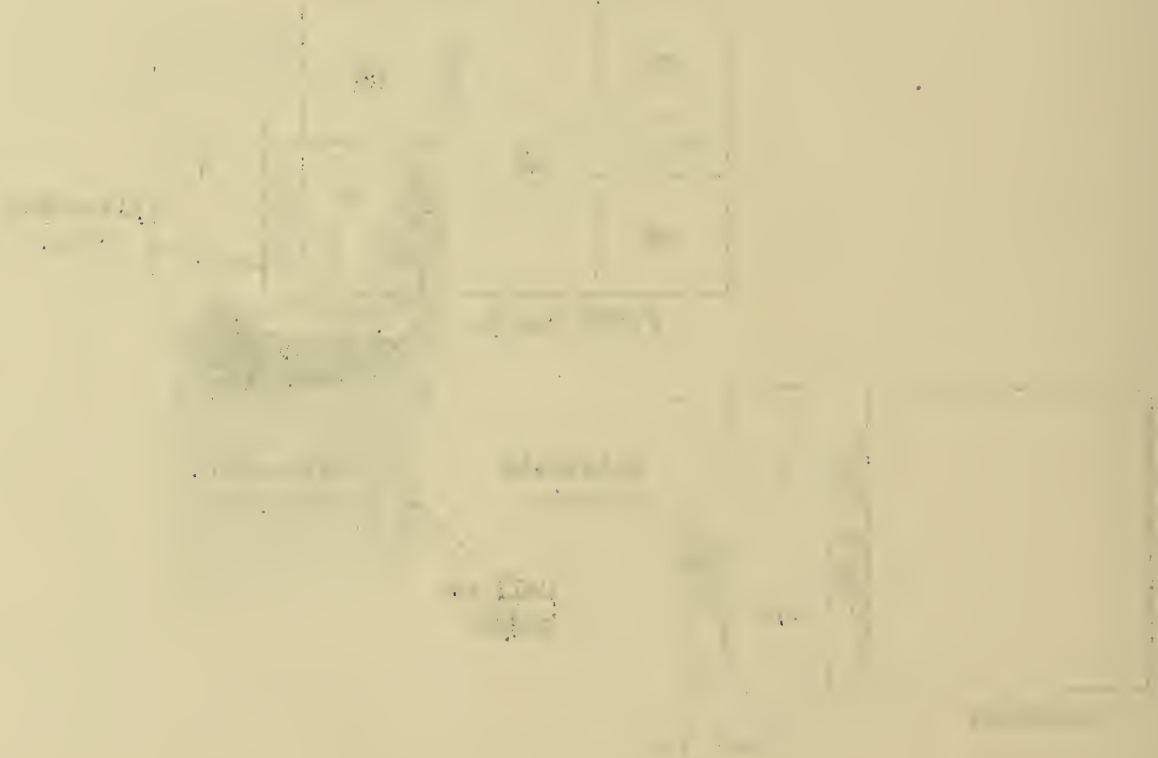
One solution is to use an enlarged driveway in front of the house which can be used for delivery space and as a service yard. This involves additional expense over the types previously shown, due to the fact that additional driveway area and a screening wall are required. The service area is large and is placed in a very predominant spot. The final appearance of the home depends greatly on the quality of the house design and landscaping and also upon the surrounding houses.

House #7

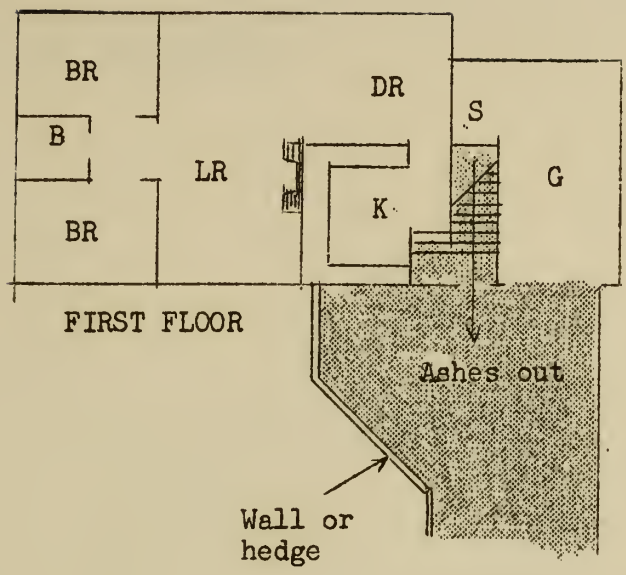


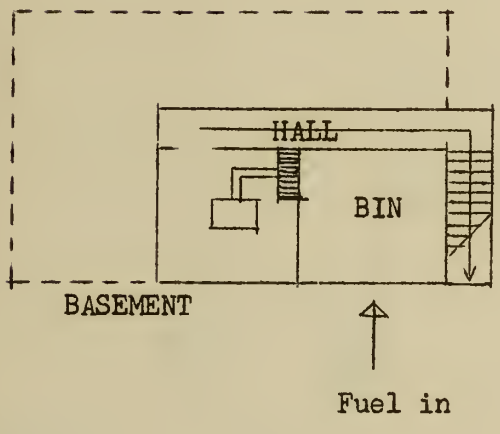
Comments

Garage parallel with the house front, stair can be made to serve all parts of the basement and the kitchen. Alternate stair serves only the firing room in the basement, but is more suitably located for garage and kitchen. Central heating plant not located properly for warm-air gravity system. In general, an unsatisfactory arrangement— hard to landscape. One advantage— bin is in the basement, requiring no extra



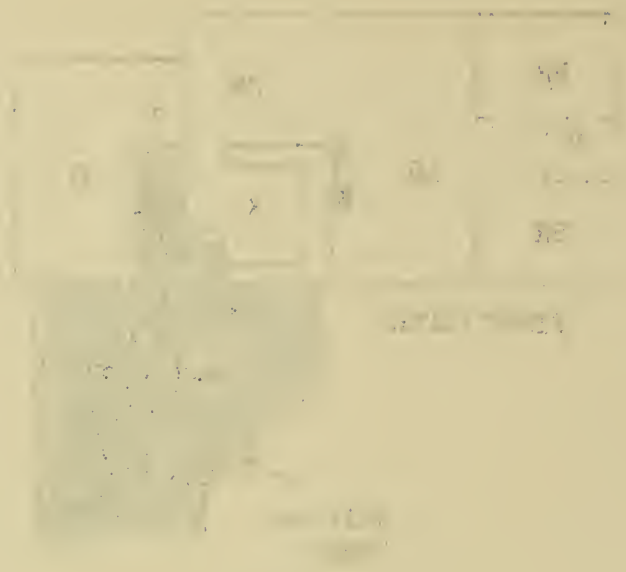
House #8

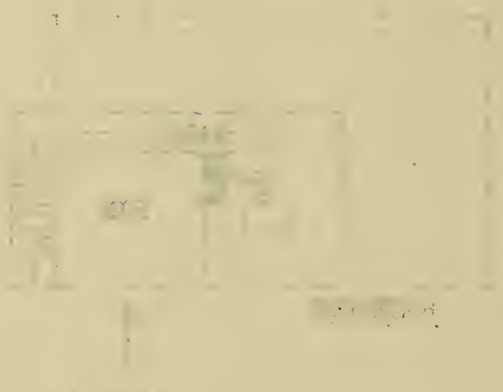




Comments

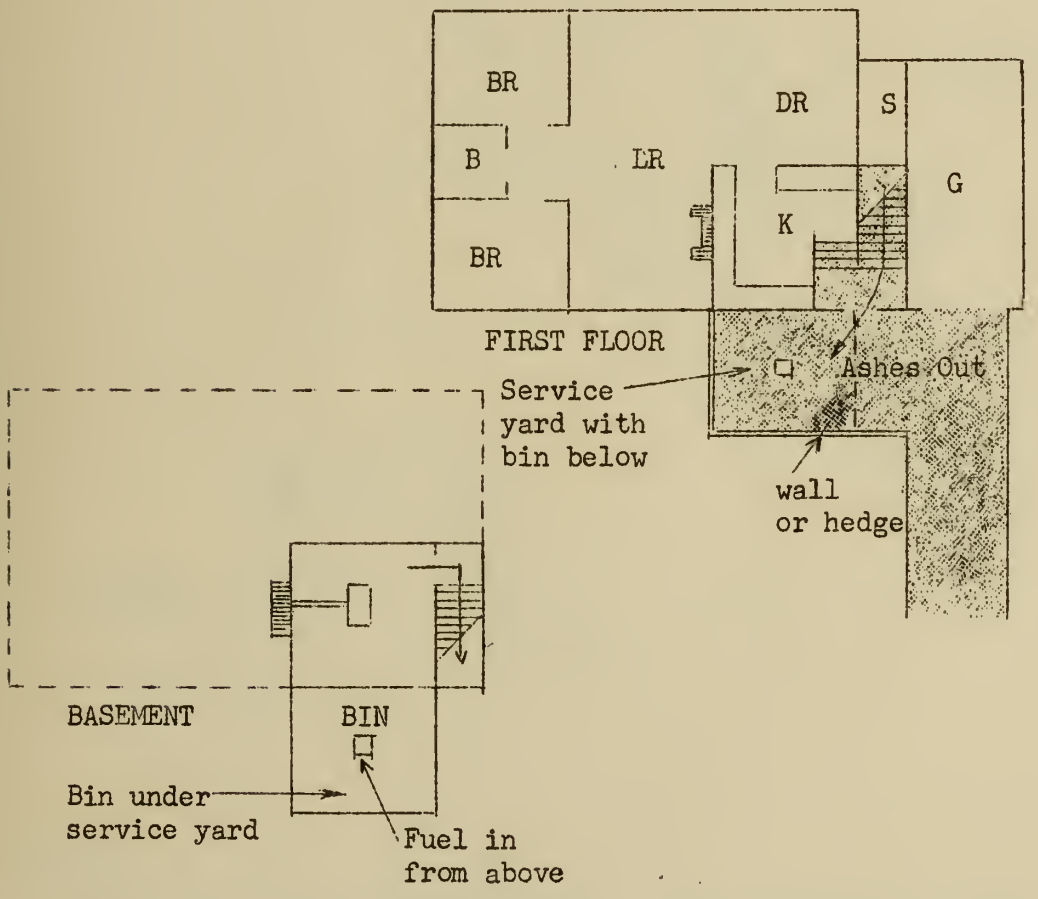
Garage parallel with the house front. Furnace unit is more centrally located. Stair is well located for serving garage, kitchen (at front of house), and all parts of basement. However, ashes must be carried farther for removal. In general, an unsatisfactory arrangement. One advantage-- bin is in the basement, requiring no additional foundation construction.





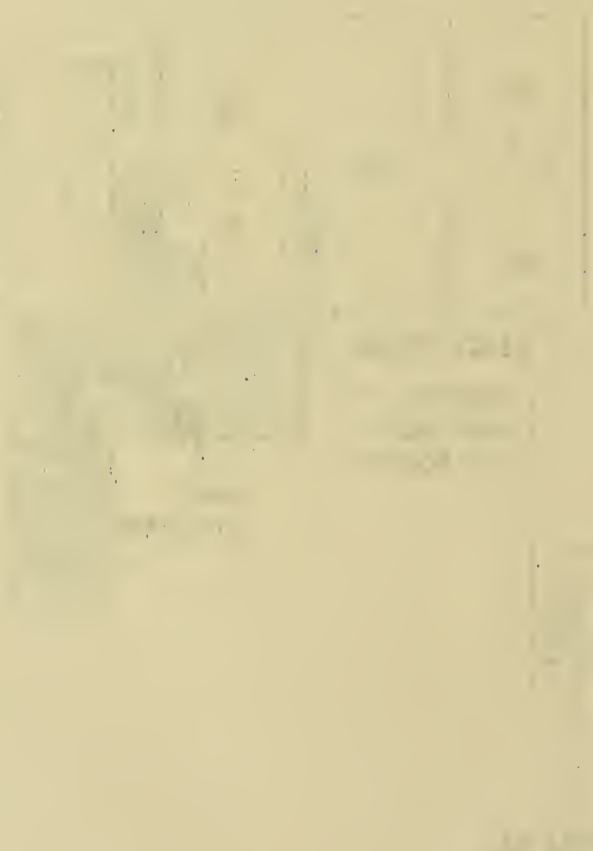
A much more satisfactory solution is the house shown below. This house has a service yard which is smaller because it is not used for truck access. Although there is additional expense involved in constructing the bin under the service yard, considerable expense is saved by using a much smaller driveway. The service yard is much more easily screened from the street.

House #9



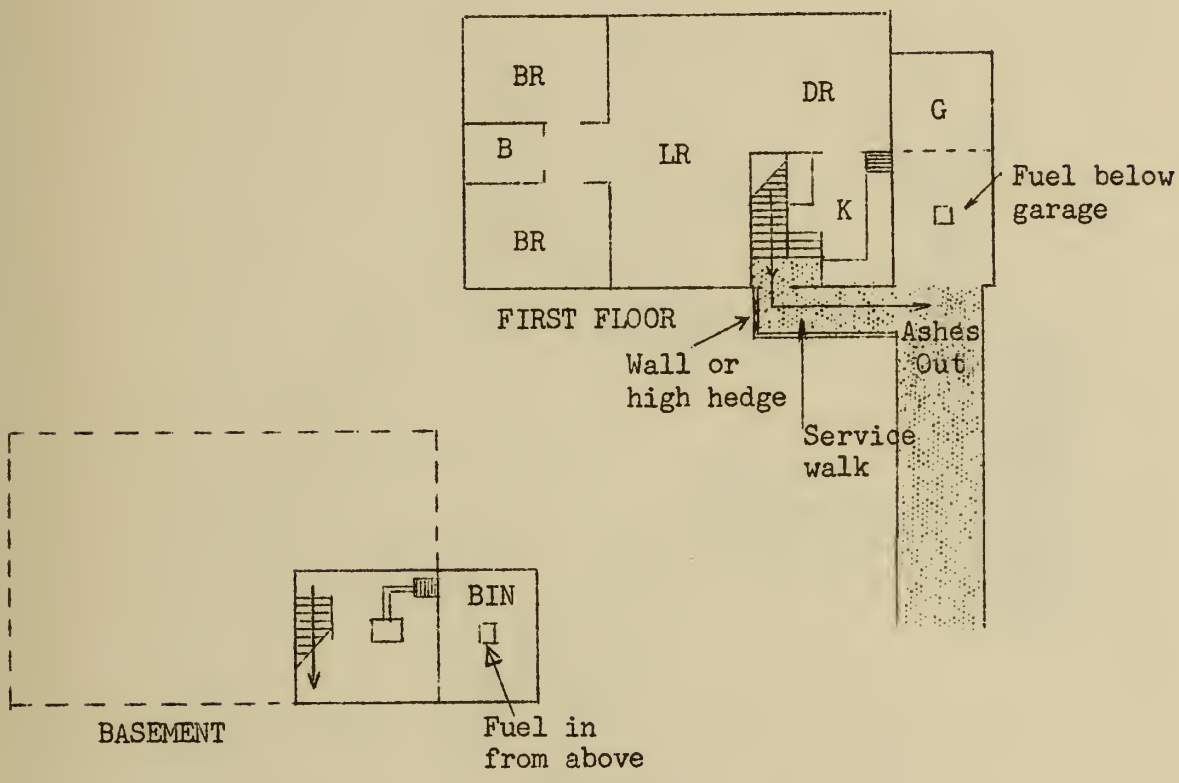
Comments

Garage front parallel with the house. Coal bin under service yard—delivery from truck by conveyor. Additional foundation required for this bin, but a light slab may be used as it will not have to support a car or truck. Service entry serves kitchen (at front), garage, and all parts of the basement.



Other houses with still smaller service areas at the front are shown below. This scheme is probably less expensive than the previous house.

House #10

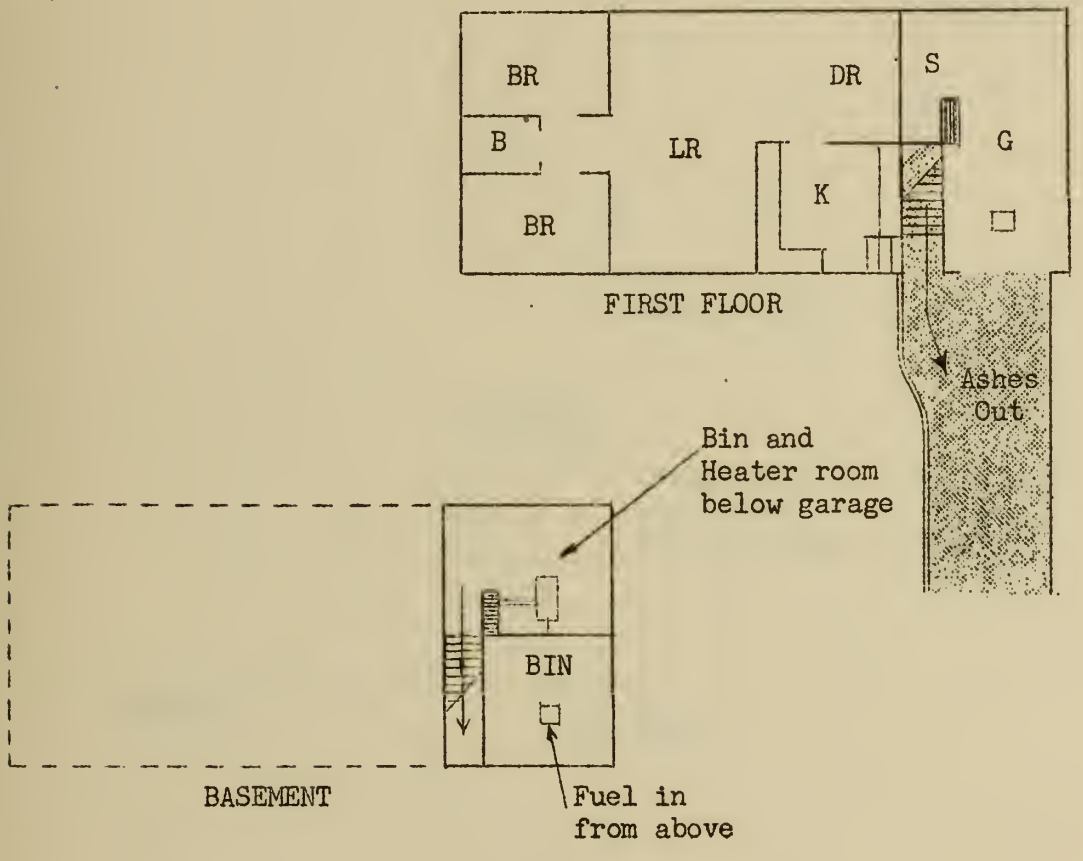


Comments

Garage front parallel with the house. Coal under garage — delivery from truck by conveyor. Service entry serves kitchen (in front of house), and all parts of basement, but not garage.

A more expensive scheme due to placement of both heater room and fuel storage under garage. There is, however, the possibility of developing this scheme into a standard unit of garage and heating plant. This area could be the only excavation required for the house.

House #11

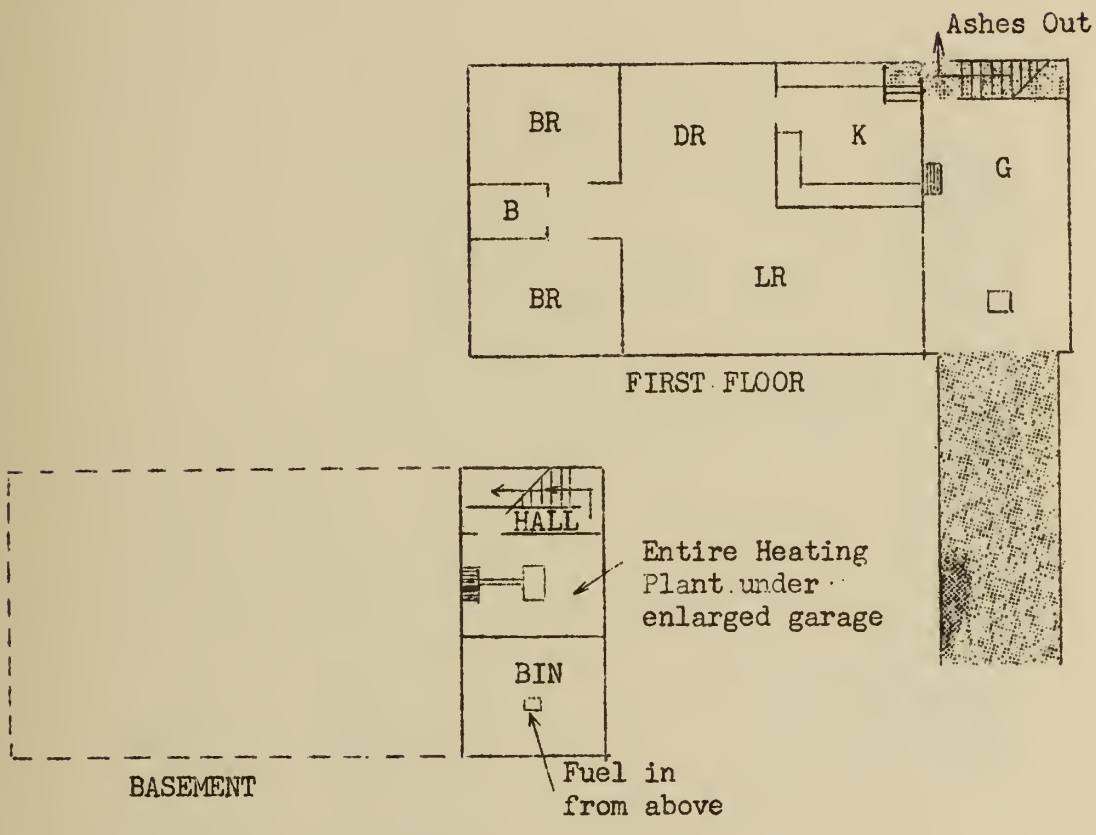


Comments

Garage front parallel to the house. If remainder of basement is not excavated, omit wall forming hall. Service entry serves garage, kitchen (in front), and all of the basement. Coal delivery by conveyor. Coal storage and heater room under garage -- space must be enlarged to provide for stair. Stair may crowd duct space needed from heater room to house.

Another house with heating plant and fuel storage both under the garage.

House #12



Comments

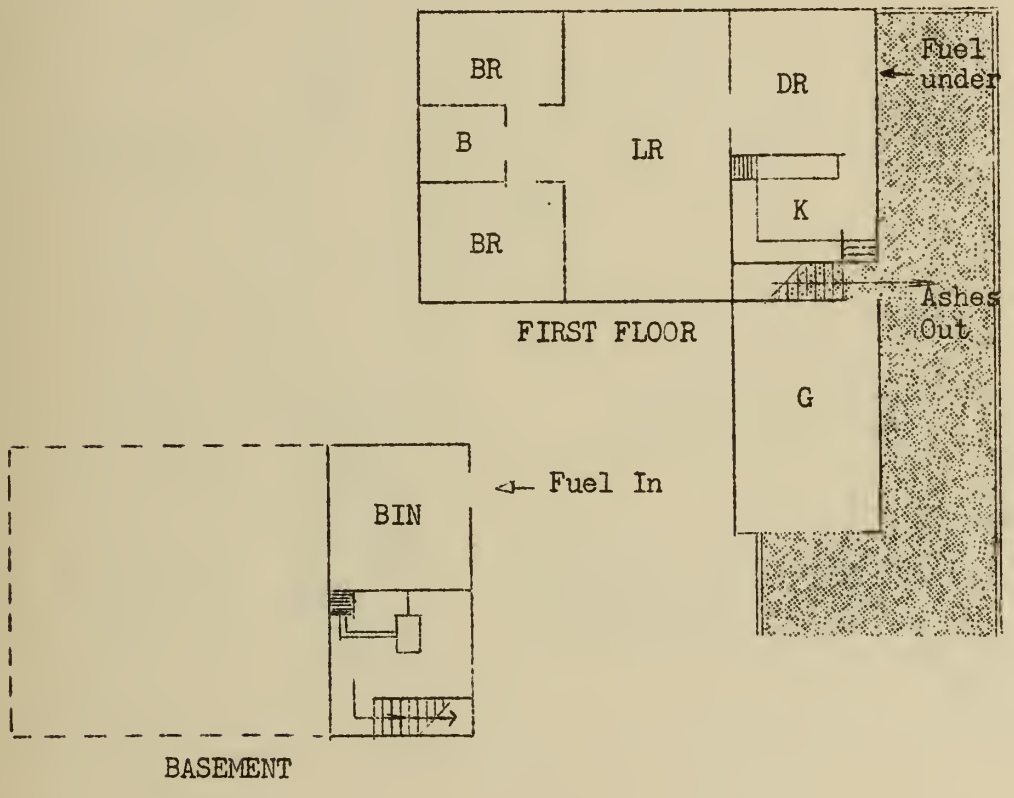
Garage front parallel to house. Service entry serves garage, kitchen (in rear), and firing room. If the remainder of the basement is excavated, it can be reached through the heater room, or a hall may be constructed as shown. Ashes must be carried around garage to reach driveway. Enlarged garage required.

4. Garage Attached— Set Forward of House

When houses are built with the garage set forward of the house, difficulties arise in planning for the delivery of solid fuel.

One solution is to provide an extra driveway to be used for fuel delivery. This driveway will also serve as a service yard, drying area, and supervised play area for children. In this house the fuel storage and heater room are in the basement of the house proper.

House #13

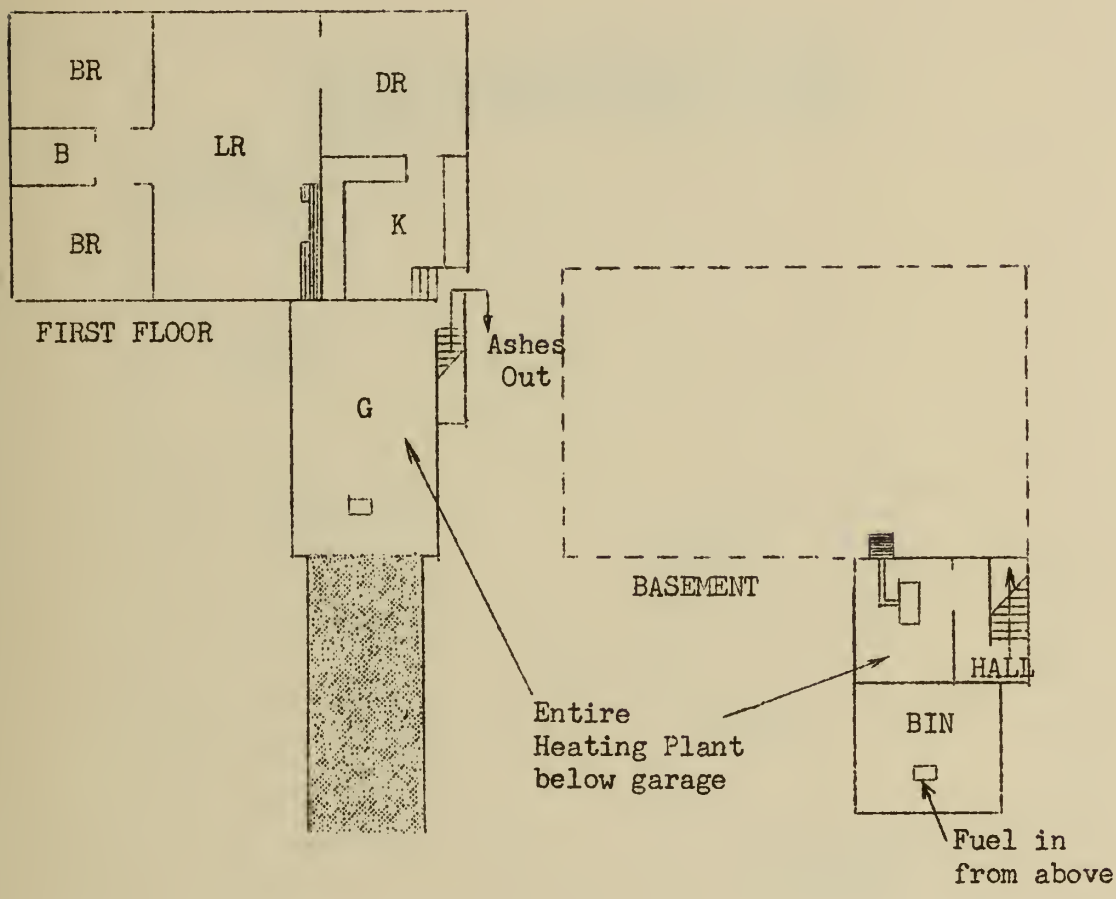


Comments

Garage set forward of the house. Service entry serves garage, kitchen, and all parts of the basement. An additional length of 30 to 40 feet of driveway is required, but this areaway serves also as a service, drying, or playing yard.

Another solution with fuel storage and heater room under the garage.

House #14



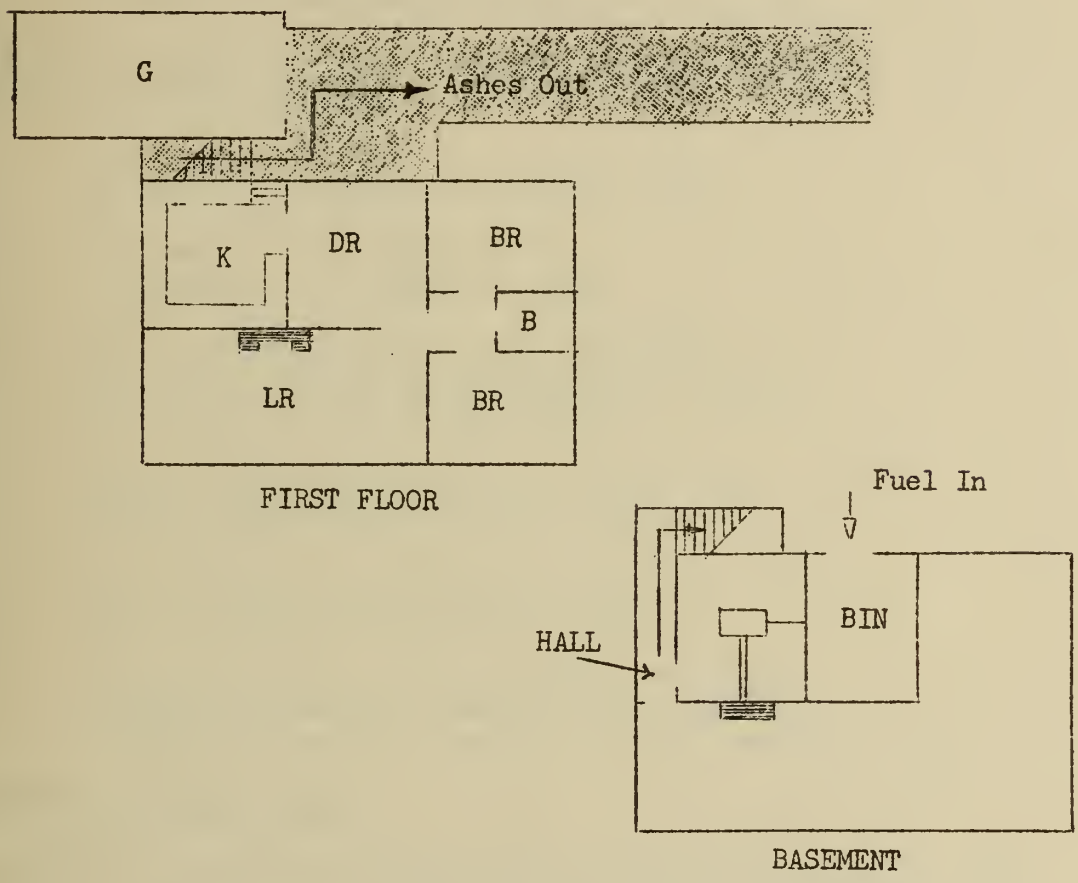
Comments

Service entry serves kitchen (in front), garage, and firing room. If the remainder of the basement is unexcavated, omit the wall forming the hall. Heater room, fuel storage, and stair are under garage floor — enlarged garage required.

5. Garage Attached at Rear— House on Corner Lot

When a house is on a corner lot, it is easy to provide for solid fuel delivery.

House #15



Comments

Service entrance and stair serves kitchen, garage, and all parts of basement. Garage may be directly attached (as shown), attached with breezeway, or completely detached.

III. MEETINGS AND CONFERENCES

The writer has attended the following meetings in connection with the work of the Project:

Short Course in Residential Construction
University of Illinois, January 28, 29, 30, 1947

Convention and Exposition of National Association of Home Builders of the United States
Chicago, Illinois, February 23-27, 1947
(Forum on Heating, February 25)
(Exposition Displays, February 25, 26, 1947)

Individual conferences concerning the work of the Project were held with the following persons:

Dr. H. J. Rose, BCR
Pittsburgh, Pennsylvania, March 8, 1947

Mr. Samuel Weiss, ACCCI
Washington, D. C. March 10, 1947

Mr. A. Gordon Lorimer, A.I.A. Architect
(Technical Advisor to the Producers' Council)
New York, New York, March 11, 1947

Mr. K. R. Hare, The Koppers Company, Inc.
Kearney, New Jersey, March 12, 1947

Mr. M. R. Grover, Anthracite Institute
New York, New York, March 13, 1947

Mr. D. G. Colton, Johns-Manville Corporation
(Industry Engineered House Committee Chairman)
by phone at Manville, New Jersey, March 11 and 13, 1947.

IV. INDUSTRY ENGINEERED HOUSE

A portion of the period covered by this report was devoted to work in connection with the Industry Engineered House sponsored by the Producers' Council and the National Retail Lumber Dealer's Association. The problems involved in attempting to adapt this house for satisfactory utilization of solid fuel for heating are typical problems, and show the difficulties which can arise when no careful forethought has been given to planning for solid fuel.

The writer attended a meeting of the committee and the architect concerned with the development of the house in Urbana, Illinois February 28, 1947. During the period of March 7 through March 13 the house was discussed in conferences with Dr. Rose, Mr. Weiss, Mr. Grover, and Mr. Lorimer, and also with Mr. Colton by phone.

Reports to the co-sponsors of the Residential Planning Project on the work in progress in connection with this house have been made

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by letters. Work is continuing on the house. The next quarterly report of the Project will contain a complete report on the Industry Engineered House.

V. FUTURE WORK

1. Revision of the study included in this report to include more fully all solid fuels.

2. Continuation of work in connection with the Industry Engineered House.

3. Continuation of house plan studies, and preparation of final definitive drawings of houses.

Respectfully Submitted,

Rudard A. Jones

Rudard A. Jones
Research Associate Professor
of Architecture

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